THE
ELECTRICAL REVIEW.

VOL. LXIV. MAY 14, 1909. No. 1,642.

ELECTRICAL REVIEW.

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MUNICIPAL TRADING.

THE Electrical Contractors' Association are to be congratulated on having at last gained the victory in a long-contested struggle. For years they have fought against municipal trading in electric wiring and fitting, and now they have the satisfaction of seeing a clause introduced into the "Electric Lighting Acts (Amendments) Bill" definitely prohibiting this form of unfair competition. During the report stage of this Bill last week, Lord Avebury moved an amendment to Clause 16 (power of undertakers to provide electric fittings) providing that where the undertakers were a local authority they might "through a contractor, but not otherwise," provide, let for hire, and fix, repair and remove, but should not manufacture, lamps, meters, electric lines, fuses, switches, fittings, lampholders, motors, and other fittings for lighting and motive power.

It was pointed out by the Earl of Onslow that it was extremely convenient to the consumer to be able to hire fittings from the persons who supplied either the electricity or the gas, and he said that the interests of the consumers must be considered. Lord Faber, on the other hand, had always thought it was dangerous for local authorities to become traders, and he considered that it would be particularly inadvisable to give the local authority the power proposed in the Bill, because they were under a statutory obligation to inspect electric installations. It would be unreasonable, therefore, to ask them to inspect fittings which they had themselves erected. The amendment was finally agreed to, but an additional clause was inserted, also on the motion of Lord Avebury, giving authority to the undertaker to exercise the powers of the clause—that is, to undertake electric wiring and fitting—without employing a contractor, if within three months after obtaining a loan for the purpose there is no electrical contractor carrying on business within the area of supply.

The bearing of this proviso is not quite clear. If literally interpreted, it may be taken to mean that no electrical contractor outside the area of supply can complain of a local authority carrying out electrical wiring work if there be no contractor within the area. On the other hand, a contractor within the area will not necessarily be engaged by the local authority, as there is apparently nothing to prevent the latter obtaining outside tenders.

Now that the contractors, by their persistence, have gained for the electrical industry the statutory recognition of their rights as traders and ratepayers, it remains for others to follow up the attack. If it is wrong for a municipality to compete with contractors, it is equally wrong for municipal servants to compete with individual ratepayers. Why, for instance, should a municipal engineer be permitted to compete with a consulting engineer who depends for his livelihood upon his private practice, and helps by his contribution to the rates to pay the salary of the engineer who is in competition with him. The same principle, of course, applies

to all State servants, and to some extent the principle is recognised. Thus, solicitors engaged in the State's legal work, say at Somerset House or in the Treasury Office, are debarred, and rightly so, from engaging in private practice, and the same rule, no doubt, applies to architects, engineers, &c., engaged in H.M. Office of Works. On the other hand, staff engineers in the Post Office Department have been permitted to swell the ranks of the technical teacher, a miserably underpaid profession, thus making it harder for others not so fortunately placed as themselves to make ends meet. A man cannot at one and the same time be a Socialist and an individualist. When he accepts service under the State or under a municipality he is paid by the public to do the public's work; he becomes a part of the State machinery, and must not regard himself as a subsidised individual who can take advantage of his position to compete unfairly with the private individual whose rates and taxes he depends upon. When, as engineer-in-chief to the G.P.O., Sir W. H. Preece was permitted by the Government to engage in private practice, his case was treated as an exception, but we must see to it that the exceptions do not become so numerous as to become the rule.

We regret that Lord Avebury, to whom the thanks of the industry are due for the amendments he proposed to that Bill, did not succeed in carrying his proposal to apply to the accounts of a municipality, the conditions which apply to the accounts of company undertakings. As the noble lord rightly pointed out, if the business of the local authority is mismanaged, the public suffer, and without a proper audit they have not the means of knowing what is being done in their name; hence it is not less, but more, essential for the accounts of a municipal electrical undertaking to be effectively audited than it is for those of a company. Although Lord Avebury's proposal was withdrawn under pressure of the opposition, the matter should not be allowed to drop. The Electrical Contractors' Association have succeeded in getting the thin end of the wedge into municipal electrical trading, and it remains now for the other sections of the industry to drive it hard home.

The New Patents Act.

We are glad to note that in a recent decision under the compulsory manufacture clauses of the Patents Act, 1907, the Comptroller-General has felt justified in exercising the discretionary powers vested in him by the Act, so as to defer the revocation of a patent to a date which will afford an opportunity to the patentee to take the necessary steps for English manufacture. The patent was granted as of February 22nd, 1904, to Dr. Emil Weber, for "Improvements in the preparation of clay for the casting of clay ware." The patentee alleged that the failure to work the patent here was due to the conservatism of English manufacturers rather than to any lack of effort on his part, but he had now entered into a *bonâ fide* contract giving an option to purchase the patent rights for England. On consideration of all the circumstances the Comptroller decided not to revoke the patent forthwith, but to do so on December 31st next unless in the meantime it is shown that the patented process is carried on to an adequate extent in the United Kingdom. The opportunity thus given to the patentee will doubtless be appreciated, and we hope he may be encouraged by a radical change in the conservatism of English manufacturers in the plastic arts.

Another grievance in the working of the Act has been the inquisitorial powers given to an applicant for revocation. It has been possible to obtain information on the business of a rival without the need for giving substantial reasons for the application. In order to prevent the Act being used for such "fishing" purposes, the Comptroller-General has, in compliance with the views of Mr. Justice Parker, issued some important orders amending the procedure under Sec. 27. The applicant will be required to state the particulars upon which he relies in support of the allegations contained in his application. The patentee will respond stating whether or not the allegations are correct, and if incorrect he will give particulars of such inaccuracy. The applicant will then submit further declarations, and the Comptroller will then determine whether a *prima facie* case has been made out.

From the report of the Comptroller-General for 1908, recently issued, it appears that under Sec. 27, which provides for the revocation of patents worked exclusively or mainly outside the United Kingdom, 15 applications were made. Two of these were abandoned, in 2 cases the patent was revoked, and 11 cases are pending.

The Brush Co.'s Report.

Seldom have we seen a report of an electrical manufacturing company which formed more doleful and hopeless reading than that which has been issued by the Brush Electrical Engineering Co., Ltd., this week. There has been a serious loss on the year's operations. The gross profit of £28,213, reduced by general charges and maintenance, leaves a net profit of only £2,614, but debenture and interest charges require £17,798, and £24,174 is put to meet bad and doubtful debts and depreciation of stocks, so that the general reserve fund of £10,229, commenced last year, has been swallowed up, and a debit balance of £29,128 is carried forward.

Turning to the balance-sheet, we find that "patents and goodwill" still stand at £100,000 "as per last account." "Shares and debentures at or below cost price" figure at £99,586. Freehold and leasehold factories and lands now stand at £308,112, which includes £8,061 for additions made during the year. On the other side, among the liabilities, there is the advance of £30,740 from the British Electric Traction Co., Ltd., which is repayable in twelve half-yearly instalments commencing January, 1909, and there is also a liability on undertakings promoted by the company and shares in other companies amounting to £73,987. Messrs. Cooper Bros. & Co., the auditors, in their report, say that the inventory of stock has been taken by employés of the company. "The shares and debentures have, as to about one-half of them, published prices, and the values at such prices show a reduction upon the figures in the accounts. We are unable to verify those not having published prices, about one-half of which appear to be of small value. During the year certain of the patents have expired or been allowed to lapse. No provision has been made for depreciation for the two years ending December 31st, 1908."

That the adoption of metal-filament lamps would lead to a temporary falling off in the demand for generating plant and all that goes to make up what we understand as "extensions" to a lighting station, has, of course, been recognised, and the Brush Co. are feeling the effects as are some other plant suppliers. But they are taking the bull by the horns and laying themselves out to push the sale of these lamps. The more energetically this is done, if, as a result, it brings the gas consumer over to electricity, the sooner will there be a revival of the demand for generating plant. The Brush Co. and the British Electric Traction Co. are, of course, very closely related, and many of the orders of the subsidiary concerns of the latter company, when they have any to give out, may be expected to go to Loughborough. Apparently their requirements have been very small during the past year. The reports of some of these subsidiary companies show capital expenditure practically at a standstill. For instance, the Dudley, Stourbridge and District Electric Traction Co. spent on capital account £454, chiefly on the extension of a car-shed and a

sub-station. But this is not an experience peculiar to the B.E.T. Companies, for the Cork Electric Tramways and Lighting Co. reports that capital expenditure during the year was mainly for "house services and cables." And there are many other undertakings of a like description to these which have had a quiet year in regard to expenditure upon new work, though in the natural course of things most have had to spend something upon renewals and repairs, but this is work which may not do much to benefit such manufacturing companies as the Brush Co. The smaller companies, like the smaller municipalities, have not been spending heavily, but the larger companies and municipalities have both had larger requirements, and for this the growing demand for electric power is no doubt responsible. Probably the London companies would have spent a great deal more last year but for the big power Bill craze which was altogether too prolonged, and has really done the industry harm rather than good. There are some large North London undertakings of the B.E.T. Co. which have had to spend capital more freely because they have not got anywhere near the end of their development stages, while in Auckland, N.Z., we have perhaps one of the brightest jewels in the B.E.T. crown, as readers will have observed from the report in our "City Notes" last week. We hope that British manufacturers will note this last point, as they have so much to gain by interesting themselves in the development of electrical undertakings abroad. Given the necessary financial support in the securing and working of concessions, there seems to be no more promising field of enterprise at the moment. This affords an interesting diversion while awaiting a revival of tramway and light railway enterprise at home, and a renewal of generating station extensions, as the metal-filament lamp produces the effect which we are all devoutly hoping for and confidently expecting. But this is only one direction for providing an outlet for our temporarily pent-up energies, for the reduced demand for its staple manufactures has led the Brush Co. to investigate other openings for activity in the industrial applications of electricity, and its experts are engaged on developments in "special branches which hold out encouraging prospects." Everybody will hope that these prospects will mature into tangible business, and already the company seems to have secured a good mill electrification contract from the Fine Cotton Spinners' Association, though the exact number of mills to undergo conversion is "wrop in mystry," as reports vary. But it will require many contracts of such value, executed at profitable prices, to put the company on a sound footing and enable it to meet its interest charges and provide for depreciation, let alone pay dividends, as anyone who examines the report will see.

Capital and Labour.

In the current issue of the *Iron and Steel Times* Sir Benjamin Browne contributes a short article on capital and labour, containing, as he says, some rudimentary truths of political economy. He reminds us that wealth and industries are the products of three factors—labour, capital, and enterprise or management, and that labour dissociated from the other two factors is of but little value. He then proceeds to point out that employment in great industries is practically dependent upon the employer's ability to find capital, the employer, in his turn, depending on a similar ability on the part of the consumer.

Continuing, he argues that political disturbance of trade, and especially Socialistic teaching, "have the absolute and invariable result, in the long run, of making rich men richer and poor men poorer." The reason for this is that, if capital is intimidated and disturbed, it will only consent to remain on condition that it gets a larger and larger share of the profit, which, of course, leaves so much less for labour.

This argument applies more particularly to what might be called the great industries—that is to say, the industries dependent upon the "capitalist employer." But, according to Sir Benjamin, the "small employers" employ altogether far more than are embraced in all the large works put together; what becomes then of his argument that labour is of but little value apart from capital, unless indeed we give a very broad definition to the term "capital"? An employer of one or two men would not look upon himself as a capitalist. The fact is, that it is becoming more and more recognised by those workers who are attached to large works, and who constitute a large proportion of the membership of trade unions, that capital can have no value at all when dissociated from labour, and this being so, they think, rightly or wrongly, that the profits of the combination are unequally distributed. It is this belief which is largely responsible for the upheavals which from time to time take place in the form of strikes.

It remains to be seen whether or not the schemes of co-partnership, or co-partnery as some prefer to call it, will have the effect of modifying this view, and of making the workman appreciate that the return he gets on his labour forms by no means an insignificant part of the total profits, but, on the contrary, often the greater portion.

Aerial Lines.

The following quotation from our contemporary, the *Electrical World* of New York, serves to show the sharp contrast that prevails between American and British practice in public electricity supply:—"When several electric companies for various service are operating in a city, the question of pole locations becomes very troublesome. Underground distribution, desirable as it is, in most places is quite prohibitive in cost. To enforce it generally would imply depriving part of the community of the benefits of electric service entirely, or permitting them to have it only at very high prices. . . One line of well-located and well-set poles can give service more cheaply and effectively than the usual tangle to be found in the streets, and there is no serious objection to its use." It appears that by negotiation it has been possible in Los Angeles to establish joint user of over 10,000 poles—and "Los Angeles is a city that has been very progressive in electrical matters!"

Our contemporary concludes that "the tangled pole lines of most cities in this country are altogether objectionable," and we are very far indeed from advocating the general use of pole lines in British cities. But surely the authorities ought to allow more freedom in the supply of small towns and villages by overhead conductors, under suitable regulations; there is no fear of British overhead lines ever becoming the unsightly networks referred to above—they need be no more objectionable than the existing telegraph and telephone lines which are tolerated even in our greatest cities. We suffer from too much Government.

American Electrical Depression.

We suppose that the annual reports of the General Electric Co., of Schenectady, may be regarded as a pretty reliable indication of the state of electrical industry in the United States as a whole. If that be so, then the past 12 months was a most unhappy period, for so severe and continued was the depression that the sales billed fell off from $71,000,000 to $44,540,000, and the orders received dropped from $59,300,000 to $42,186,000. That is a fall of $26,460,000 in the former, and over $17,000,000 in the latter; but it ought to be mentioned that the previous year was far and away the best the company had ever had, and its business was largely in excess of the year before that. The net result of all this, after meeting dividend payments, is a deficit of $411,773, which has been charged to surplus account. We read in the *Electrical World* that the value of orders received during the year was only 70 per cent. of that for each of the two previous years, and shipments to customers only 63 per cent. of the shipments for 1907. "The great and sudden shrinkage in the business has, because of the difficulty in reducing expenses, resulted in great increases in the ratio cost of selling prices, with a corresponding decrease in the percentage of profits. It is stated, however, that since the close of the year these conditions have improved, and the outlook for the ensuing year is said to be encouraging."

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A point of interest is that, notwithstanding the aggregate shrinkage, there was an increase in the number of orders received, but the average value per order was 30 per cent. less. Our trans-Atlantic cousins are possessed of a most healthy optimism, and already they are trying to forget that there ever was anything in the nature of depression. Note this paragraph from the *Electrical World's* editorial on the subject:—"There is no reason in sight why next year should not see any and all of the peaks of the past overtopped, yet on a more stable basis of prosperity because of the increase in population and wealth and the growing use of electrical energy and apparatus."

No one will be better pleased than we in this country if our American friends experience a great revival, for a good deal of our own trade depression followed on the heels of that financial panic of theirs that shook the markets of the world—perhaps we shall now all revive together, for already there are signs in the sky, though they may appear to be no larger than a man's hand.

Shilling-a-Dozen Telegrams.

Mr. Henniker Heaton's hallucinations on the subject of telegraphic communications seem to be beyond the reach of cure without the aid of a surgical operation. Speaking at a dinner of the Imperial Colonial Club on Friday, he said he had hopes that within a few months it would be possible to send messages to every part of the British Empire at a cost of 1s. for 12 words. He had the particulars of an invention by which 60,000 words could be transmitted in an hour.

Mr. Heaton surely must know — but apparently he refuses to believe—that any such proposition as the former is at present absolutely incapable of accomplishment; to speak of it as being within the range of a few months is, no doubt, sufficient to bring a transient round of applause from an audience unacquainted with the true state of affairs, but that is all. As for the 60,000 words an hour, this looks like the Pollak-Virag system, which, as we have repeatedly pointed out, cannot possibly be used for submarine telegraphy. If Mr. Heaton is unable to grasp these facts, we can only offer him our condolences.

Motor-Converters at the I.E.E.

On Thursday evening last week, the Electricals foregathered at the Society of Arts to hear Mr. Hallo champion the cause of the motor-converter. The discussion, of which one would have liked more, resolved itself—as is usual when motor-converters or rotaries are in question—into a debate on the relative merits of the rival apparatus.

It is a matter for regret that no one could, or at any rate did, speak from experience of both types of machine. At Manchester, when Mr. Miles Walker took up the cudgels on behalf the rotary in December, 1906, we have a recollection of certain remarks made by Mr. S. L. Pearce, and based on experience with the Manchester Corporation and Central London Railway plant, which could only be interpreted favourably to the motor-converter.

Practically every one admits that there should be a slight gain in efficiency with the rotary, and Mr. Seabrook was no doubt justified in trying to capture this 1 or 2 per cent., by employing rotaries in connection with his day and night loads in West Ham. But many people when considering questions of flexibility in operation, will ask themselves whether the rotary with its transformers, L.T. cables, and possibly switchgear, starting motor, booster or induction regulator, &c., does not more than equal the cost of the motor-converter, and exceed the space taken up by the latter. Readers who are interested in this matter will find views of 800-kw. rotaries fitted with starters and boosters, and motor-converters of similar capacity installed in a Bristol sub-station, in our issue of February 19th last, the transformers for the rotaries being in the basement, and therefore not visible. To sum up, it must be admitted that there are many 50-cycle rotaries in use, and giving complete satisfaction, but that the rotary can do everything that the motor-converter can do under the same conditions, and with better commercial efficiency, is a matter which, it seems to us, the partisans of the former machine have yet to prove.

THE CONDITIONS OF ELECTRICITY SUPPLY IN RUSSIA.

In an interesting article in the *E.T.Z.* for April 15th, 1909, Herr Carl Schmidt discusses the technical and financial conditions governing the supply of electricity in the smaller Russian towns. He points out that two important differences, as compared with the average Western European towns, exist—viz., the more scattered arrangement of the towns and the smaller amount of illumination which satisfies the inhabitants. For these reasons any form of lighting involving large initial expense is quite out of the question, and even gas works have not found a general footing—most of the smaller towns being still content with petroleum lamps in the main thoroughfares, and omitting all lighting in the by-streets and suburbs.

A newly-established electrical supply station is, therefore, faced with the problem of supplying a better street illumination without exceeding the cost of the existing petroleum lighting.

Up to the present, when changing to electric light, arc lamps have usually been employed both in the main and in the by-streets, but with the distance between lamps increased to 200 metres or more. With this arrangement the road illumination varies enormously, being about 7 lux (·66 candle-feet) immediately under the lamp and ·007 lux midway between two lamps, whilst more than half the space has an illumination under ·02 lux. With petroleum lamps of 12 c.p. suspended 3 m. from the ground and 25 m. apart measured along the road (width of road about 15 m.) the maximum illumination is about ·7 lux and two-thirds of the road has an average of ·02 lux.

With the aid of metal-filament lamps of 25 or 50 c.p. a much more favourable result can be attained with electric lighting. Thus using 50 c.p. lamps suspended 5 m. from the ground, and allowing 40 m. of road per lamp, the maximum illumination is 2 lux and two-thirds of the space averages ·06 lux—*i.e.*, about three times as great as with the petroleum lamps.

The cost comparison works out approximately as follows (1 kopek = ·26d. and 1 rouble = 2s. 2d.):—

Cost of a 12-c.p. petroleum lamp per lamp-hour = ...	·5 kopek
Cost of a 12-c.p. petroleum lantern and post = 10 roubles:—	
Therefore, interest, depreciation and sinking fund per lamp hour	·05 kopek
Maintenance per lamp-hour...	·25 kopek
Total cost per lamp-hour ...	·8 kopek

For 8-c.p. petroleum lamps the cost works out at ·65 kopek:—

Cost of 50-c.p. tantalum lamp per hour using 80 watts at 10 kopek per kw.-hour = ...	·8 kopek
Cost of 50-c.p. tantalum lamp, including support, leads and switching apparatus = 30 roubles. Therefore, interest, depreciation and sinking fund per lamp-hour	·15 kopek
Maintenance (replacement of lamps) per lamp-hour ...	·22 kopek
	1·17 kopek

As there will be only about half as many electric lamps as gas lamps, it is clear that the cost of electric lighting will be little, if any, more than that of the petroleum lighting.

In projecting an electricity undertaking, the street lighting, of course, only forms a small portion of the scheme, and provision must be made for probable extensions for private lighting, power and tramways. The following statistics show the rate of progress in the year 1905 to 1906 of a number of existing electric supply stations:—

In 21 towns with over 200,000 inhabitants, the output increased 21·94 per cent., from 16,900 to 20,550 kw.-hours per 1,000 people.

In 18 towns with between 100,000 and 200,000 inhabitants, the output increased 32·55 per cent., from 15,000 to 19,900 kw.-hours per 1,000 people.

In 26 towns with between 20,000 and 100,000 inhabitants, the output increased 27·28 per cent., from 9,890 to 12,550 kw.-hours per 1,000 people.

In 29 towns with between 22,000 and 50,000 inhabitants, the output increased 24·6 per cent., from 14,600 to 19,200 kw.-hours per 1,000 people.

In 28 towns with between 5,000 and 21,000 inhabitants, the output increased 5·77 per cent., from 27,900 to 29,500 kw.-hours per 1,000 people.

In 13 towns of under 5,000 inhabitants the output increased 17·35 per cent., from 22,050 to 26 600 KW.-hours per 1,000 people.

The consumption per 1,000 inhabitants is in all cases based on the population in 1905.

It will be seen that the smallest per cent. increase, and at the same time the largest individual consumption, exists in towns having from 5,000 to 21,000 inhabitants.

It seems probable that a species of saturation has had time to be set up in these towns. The increase, again, for towns under 5,000 inhabitants, is probably accounted for by the incompleteness of the statistics with reference to these.

The statistics show that in all cases the increase is chiefly due to power consumers rather than to lighting.

The writer reviews the pros. and cons. of the various systems, and comes to the conclusion that for the average small town in which the radius of distribution does not exceed about 1¼ miles from the supply station, the three-wire 2 × 220-volt direct-current system is superior to any high-tension alternating system. In the larger towns a high-tension three-phase supply is recommended, a direct-current supply for tramways being arranged either in the same station or in a separate station.

In most Russian towns, land in the central portions is still cheap and ample provision for extensions should be made.

As an indication of the possibility of profitable electric supply, the writer works out a typical case of a town of 40,000 to 50,000 inhabitants.

The present cost of street lighting with about 800 petroleum lamps each burning 2,000 hours a year at ·65 kopek per lamp hour will be 10,400 roubles (£1,120).

In place of these, it will be necessary to use, say, 40 8-ampere arc lamps taking 16 KW., and 300 50-C.P. tantalum lamps taking 27 KW., all burning for 2,000 hours a year, therefore, the total KW.-hours per annum = 43 × 2,000 = 86,000. The charge for lighting must be as before, 10,400 roubles. The private consumer will have connections for about 140 KW., and will use about 70 KW. for 1,000 hours per annum, therefore, the total KW.-hours = 70 × 1,000 = 70,000. The output at the bus-bars will, therefore, be 113 KW., and the total KW.-hours = 156,000.

This will necessitate the provision of two 100-H.P. generators (66-KW. output each at 2 × 220 volts), and a battery for, say, 50 KW., giving a maximum possible output of 182 KW. in all.

With an overhead distribution the capital cost of house connections and meters, but excluding wayleaves, will be about 170,000 roubles (*i.e.*, about £100 per KW. connected). For wayleaves about 20,000 roubles may be assumed. The income will be :—

For street lighting	10,400	roubles
For private lighting at about 24 kop. (6¼d.) per KW.-hour	15,600	,,
Meter rents, &c.	2,000	,,
Total	28,000	,,

The expenses will be :—

10 per cent. interest, depreciation, and sinking fund on 170,000 roubles	17,000	roubles
5 per cent. interest on 20,000 roubles	1,000	,,
Direct expenses at least	12,000	,,
Total	30,000	,,

It will be seen that at the best a small loss must be expected for the first year or two, and, under the present disturbed political conditions, the rate of increase in consumption is likely to be very slow, so that even with the small machines chosen, no additional plant will be required for at least four years, and probably not for considerably longer.

South Africa.—The A.E.G. Electrical Co. of South Africa, Ltd., have in hand, according to the *British and South African Export Gazette*, orders for the supply of a 300-H.P. and a 160-H.P. motor to the Geldenhuis Deep, Ltd., eight 50-H.P. and two 60-H.P. motors to the Nourse Mines, Ltd., and four 125-H.P. motors to the Crown Deep, Ltd. The same firm have received an order for five electric winding hoists and a 1,000-KW. generator for the Randfontein Estates Gold Mining Co., Witwatersrand, Ltd.

CORRESPONDENCE.

Letters received by us after 5 P.M. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Suction Pipes for Condensing Plants.

I was pleased to read Mr. Alington-Johnston's criticisms of my article on "The Design of Suction and Delivery Pipes for Condensing Plants" in your issue of the 30th ult., and wish to reply to these. Mr. Alington-Johnston states that in his opinion armoured rubber hose is a very weak link in a power station's pipe line, and that there are few, if any, modern power stations which possess such an arrangement, and those which may have had the misfortune to possess one have discarded the arrangement. The power station to which I referred as having 12 rubber suction limbs is similar to that Mr. Alington-Johnston has had experience with, in being of over 6,000-KW. capacity, and is a modern up-to-date steam turbine station.

The arrangement of rubber suction limbs may, at first sight, seem weak, but when I mention that it was the only possible satisfactory solution to the circulating water question in this case, and that during the seven years the station has been in operation it has never failed, I think Mr. Alington-Johnston will agree with me that it has not proved to be weak.

Further, there are altogether eight works on this particular river alone that I know of which have a similar system of rubber hose suction limbs. One of the above, which is a power station, adopted rubber suction limbs 19 years ago after having tried various other arrangements, none of which were satisfactory. The river in question is also a tidal one.

Mr. Alington-Johnston says that "depreciation is rapid, due to continual immersion and strain on rubber and wire armouring when they are hauled up with tackle for cleaning purposes. The bending cracks the rubber and strips the wire." This has never been the case with the pipes under discussion, and it has been ascertained from the older station mentioned above that the average life of a rubber pipe is 12 years at least. The pipes are made of good quality rubber, with a steel spiral embedded in it, and are covered both inside and outside with canvas; possibly in Mr. Alington-Johnston's case the spirals were not embedded properly, or the rubber was not of good quality.

There is occasionally a difficulty in getting at the suction limbs for cleaning purposes, due to the water not going down low enough. This occurs at neap tides or when there is a "fresh" in the river, and at such times the strums are often left for three or four days. When got at they are very dirty and are generally buried in the material which they have drawn towards them. I fail to see how Mr. Alington-Johnston's immobile perforated cast-iron pipes would be satisfactory under such conditions.

The operation of cleaning these strums is a simple one, and the whole 12 can be done by two men in one and a-half hours, which time includes that for launching and also getting boat out of water again.

As regards Mr. Alington-Johnston's proposal as to bedding these pipes, I doubt whether any river Commissioners would agree to the dumping of boat-loads of stone into the bed of a river, and even if this were done there would still be the danger of this bed silting over. Another advantage of rubber pipes is that they can be easily temporarily diverted to allow for dredging operations.

I hope Mr. Alington-Johnston will pardon me telling him that the particular armoured rubber suction hose pipes on the pipe line mentioned, which he says he did not design, but had the misfortune to be in charge of, and which he says were discarded after endless trouble and maintenance, are still in use, but new strums, having an area of 10 times that of the old ones, or 20 times that of the pipes, have been fitted. There has never been a stop of even five minutes since these have been fitted, and no trouble has been experienced during the autumn and winter months.

I admit that the dock arrangement is the ideal one, but when the river recedes some distance from the quay wall at low tide, a great deal of expense is incurred in the frequent redredging of the channel to the dock, which channel has

been found by experience to quickly silt up. The timber jetty arrangement with wooden or expanded metal screens is a good one, but again expensive if the river recedes far back from the quay wall.

W. G. T.

In reference to an article in your issue of April 23rd, headed "The Design of Suction and Delivery Pipes," and to Mr. Alington-Johnston's letter, "Suction Pipes for Condensing Plants," in your issue of April 30th, I may say that I also claim some small experience with rubber suction pipes.

Mr. Alington-Johnston will be interested to learn that a large lighting and power company in the North of England has used this system for the last 19 years, and, strange to say, in this company's main power house there are 12 10-in. rubber suction pipes.

This power house has a capacity of 6,500 KW., and deals with peak loads of over 5,000 KW.

These rubber suction pipes dealt with 1,400,000,000 gallons of water during the year 1908, and the average condenser vacuum for that time was within 1·1 in. from the barometer readings.

The repairs to the suction pipes for the last seven years amount to something like ·00032d. per KW. generated.

As this is a modern power station, and, according to Mr. Alington-Johnston, it has very weak links in its pipe lines, I should be interested to know if he is able to do better with any other system.

William Middleton.

Newcastle-on-Tyne,
May 3rd, 1909.

St. Albans Destructor.

Your note with regard to the St. Albans refuse destructor is interesting, in fact, so interesting, that I should like to ask Mr. Ruthven Murray to publish the results of his test in your journal.

St. Albans, being a small country town in an agricultural district, cannot be expected to produce refuse of a very high calorific value, yet we read of an evaporation of 2·75 lb. of water per lb. of refuse, from and at 212° F. If this be correct, the St. Albans refuse must be of almost half the calorific value of cheap coal.

For my own part I prefer a longer test than eight hours, and all engineers who have experience of destructors, and have conducted tests, know that many of the published results of eight-hour tests could not be maintained for 24 hours, and much less for a week. My experience is that a 24-hour test fairly well represents the steam raising value of the refuse, and is, therefore, of some value to prospective customers.

At a destructor lately built to my specification, the average evaporation over three months has been 1·4 lb. steam per lb. of refuse, and for a test lasting 22½ hours, with the ordinary number of stokers working, the result was 1·68 lb. from and at 212° F., and, 1·38 lb. actual. During the test the boiler was fed with cold water at 45° F., while under working conditions the pump is supplied with warm water from the condenser.

I considered these results remarkable for a two-cell plant, until I read your paragraph this week.

Oswin Hansom.

Fleetwood, *May 10th*, 1909.

Mercury Motor Meters.

With reference to the letter of Mr. Schofield in your last issue, when I inserted my first letter I quite anticipated that it would arouse the sceptical criticism of some of your readers.

What I required was an explanation of the phenomena, or the experience of others on this subject; instead of that, I received caustic comment from one who evidently doubts the genuineness of my statements. For the benefit of Mr. Schofield, I can assure him that the meters to which I referred are not of the make in which he is interested; as to the truth of the phenomena, the tests on these meters have been witnessed by others, who also remarked on the peculiar effect. Again, Mr. Schofield states that it is rather late in the day to criticise mercury motor meters; I think if he will read my first letter again he will see that my object was not to criticise mercury motor meters in general, but the peculiar behaviour of a certain type. I am, and have long been, an advocate of the mercury motor meter, and have long recognised its advantages over the commutator type of meter; as to his remarks about elementary electricity and magnetism and current from battery, I merely stated what had been advanced to me as a theory, and I did not make any comment on same.

If Mr. Schofield or others can offer a satisfactory explanation, I should be very pleased to hear same, as I have already had explanations from persons interested in meter manufacture, with which I am not satisfied.

Strebor.

May 8th, 1909.

With reference to the letter of "Strebor" in a recent issue, I can assure him that he is not the only one who has noticed the peculiar phenomena to which he refers. He states that the meters in question are on lighting loads, but I think I can go one better than him on that point, as I have seen a mercury motor meter refuse to start on a motor load with a considerable current passing, but afterwards the same meter started on a battery circuit with a small current.

Although I have noticed the phenomena, I have never found the cause; I have heard a few suggested causes, but I was not satisfied with them, and as I found that the meters worked all right in course of time I did not trouble to find a cause, but put it down as one of those unexplainable things that one sometimes meets with in electrical work. But now that others seem to be confronted with the same trouble I would like to hear a satisfactory explanation.

I never noticed any trouble with the meters regarding accuracy, although they exhibited the peculiar behaviour mentioned; I found them accurate down to low loads except for the peculiarity stated.

I do not think the letter of Mr. Schofield in reply to "Strebor" will go far towards throwing light on the problem with which "Strebor" has been confronted, neither will it favourably impress him as to the suitability of the correspondence columns of a technical paper for obtaining information on problems with which he may be faced. As to the criticism of mercury motor meters, while it is quite true that this type of meter has many advantages, still it is also true that it possesses many serious disadvantages—such as the trouble with mercury spilling while in transit owing to violent shaking, also the formation of air bubbles in the mercury chamber. Although there are many excellent devices for closing the mercury outlet, still it is a fact that mercury will escape if the meter is violently shaken, as often happens in transit.

There is another defect to which I would like to draw attention—that is, the formation in the mercury chamber of a black powder-like substance which is noticeable after the meter has been in use for some time. I have heard it stated that this is caused by the action of the mercury on the material of which the mercury chamber is composed, the substance being described as a mercurous oxide; whether this is so or not I am not sure, but probably some of your chemical readers could throw light on this point. I expect it has escaped the notice of manufacturers, as it is not noticeable until after the meters have been in use for some considerable time, but the fact is, that it impedes the armature and causes slowness, and in some cases a complete stoppage. I have seen a considerable quantity of this substance removed from the mercury chambers of different makes of meters.

There is still another disadvantage in the mercury motor meter, and that is, that if it is suddenly overloaded, either by a rush of current due to a short-circuit on the wiring or to an ordinary overload, the mercury is blown out of the mercury chamber and splashed about the case, while the armature is at the same time jammed up, if not entirely destroyed for future use.

With the commutator type of meter all difficulties of transit and chemical effects disappear, and in a meter of this type,

such as is manufactured on the Continent, there are many advantages, notably simplicity, good workmanship and reliability.

While there are many good meters manufactured in this country, still I think no one who has handled many different types of meters can dispute the fact that the commutator type meter manufactured in Germany or France can give their British competitors a long lead as regards compactness, workmanship and simplicity. When one sees the huge meter of small capacity manufactured in this country placed beside the small, compact, and at the same time reliable meter of French or German manufacture, it does not impress one favourably as to British meter practice. I have recently examined one of the latest types of German meter and was much impressed with its good points, and I think an examination of this or other type of Continental meter would go a long way towards removing the "All-British" craze of some people as regards instruments especially.

I am sure that these remarks will call forth criticism, as there are sure to be amongst your readers numbers of those people who would have you believe that nothing but rubbish is produced on the Continent, and nothing but the ideal in Great Britain. Although I have spoken in defence of the commutator type meter, I am prepared to accept the statement that the mercury motor type is a good meter provided that one or two hazy points regarding its behaviour are satisfactorily cleared up. I may add that I am not in any way interested either in the manufacture or sale of meters in this country or abroad.

Mercurio.

Advertising to the Layman.

We send you current copy of the *Cotton Factory Times*, and you will note an advertisement of great interest to electrical contractors on page 4. The intention is clearly to sell the foundation raw material direct to cotton mills so that they may scrape together an installation of a sort without the aid of the trained contractor. Of course the contractor gets his innings later on when the imperfect job has to be ripped out and reconstructed—usually daywork prices. We think, however, any firm which supplies the trade should be discouraged from offering in such an outside way the raw material for electrical engineering work. The prices also are such that we do not think a contractor could order and get the usual discount.

E. J. Dugdill & Co.

Failsworth, *May 10th*, 1909.

[The advertisement offers "electric cable casing" and other woodwork.—Eds. E.R.]

LEGAL.

THE CONSOLIDATED NICKEL, TIN AND COPPER MINE, LTD., *v.* MESSRS. CROMPTON & CO., LTD.

(*Continued from page 755.*)

Cross-examined by MR. ABEL THOMAS, MR. WILLIAMSON said he was the resident London manager of the plaintiff company, and he had had experience in connection with several mines. It was true that the specification stated that defendants intended to supply a "sinking pump of the turbine multi-stage vertical spindle type, to deliver 1,000 gallons of water per minute against a total head of 120 ft., including friction." By that he did not understand that the head of 120 was an "ideal head," and that it would not raise it because of the friction. Plaintiffs' electrical engineer, Mr. Garner, sent them reports of the working of the motor, &c., and eventually advised them that it would not be safe to pump to the full depth of 120 ft., so they issued instructions that the water level should be kept at about 90 odd feet.

MR. THOMAS TOMKIN was next called, and said he had had 14 years' experience, but before the installation of this electric plant in the Wheal Busy mine, witness had had no experience of electric pumps or gas engines. The machinery ordered from defendants began to arrive during May, 1907, and on June 3rd defendants' engineer, Mr. Cragg, came down to superintend the erection, &c. The Worthington pump was delivered on July 23rd, but it was not complete, and whilst negotiations were proceeding with regard to the missing parts a temporary pump was erected. This pump lowered the water level some 17 ft., and kept it there until the Worthington pump was installed. The Worthington pump arrived on July 29rd, and witness's men lent their aid in putting the pump, motor, &c., together, under the supervision of Mr. Cragg. In August the pump was ready, but when Messrs. Crompton's engineer endeavoured to start it, it refused to go. A three-phase motor expert came down, and then it was discovered that the rotor was rubbing against the fields. Part of the motor was then taken away, but it still gave trouble when it came back. The work the Worthington pump had done so far had resulted in an overheated bearing, and that continued to give trouble. They played water upon it to keep it cool. Men came down from Worthington's, and there was trouble generally between them and Crompton's men. In September the pump was working again, but on the 13th of that month there was another breakdown, the bearing of the motor seizing. Once more it was brought to the surface, and sent away for three days. During these various stoppages the water rose in the mine, the temporary pump having been taken away. On September 17th they tried the motor again, but a coil burnt out. A few days after this breakdown, the motor was sent away to the works. Mr. Cragg never made any suggestion that any of the trouble they were having was due to witness's men, but his men often complained about the engine, declaring that it was not governed properly. No complaint was ever made by Mr. Cragg that the engine was not driven properly. On September 20th the water had risen in the shaft until it had reached the adit level again. Just about this time a Mr. Miller was sent down by defendants, and for a period the plant worked fairly well. He left on October 13th or 14th, and on October 17th the terminals on the motor were burnt off—viz., the stator and cable connections. This defect having been remedied, they went to work again. From then to the early part of November they had a good run, and the water was lowered again in the shaft, but on November 13th the motor burnt out. This accident led him to the conclusion that the motor was not strong enough for the work it had to do. He noticed that where they were using a long suction pipe and the pump was falling off in efficiency the motor seemed to drive it more easily; but when they used a shorter suction pipe and worked the pump up to its full capacity the motor did not seem equal to the task, and the insulation burnt. Witness reported these observations to Mr. Williamson, and his report was communicated to the defendants. Before they got the pump at work again after the last breakdown the water had again risen to the adit level, and all the mining operations had to be stopped. Once more the motor was returned repaired, but the trouble continued, and just before Christmas it was sent away again. Owing to the stoppage in the mining operations, witness had had to discharge a number of men to save expense. The motor was away until March of 1908, and during that time the mine was flooded out. Since its return they had had several short stoppages, owing to the overheating of the exciter, &c., but from that time onwards Mr. Garner, employed by plaintiffs, had had charge of the electrical part of the plant. They had pumped out the water to a depth of 93 ft., and, acting on the instructions of Mr. Norbert, they had maintained the water at that level.

COUNSEL: In your opinion, would it have been expedient to pump to a lower level?—No, we were experiencing difficulties with the exciter, and considering the previous breakdowns, we were of opinion that it would be dangerous. When the motor came back, Mr. Cragg said that his people had made a change in the machine, and had given it a greater horse-power.

Cross-examined, WITNESS said that when the motor came back from being repaired in December, 1907, a portion had been taken from the rings at the end of the rotor and the vacancies had been filled with wires. The ends of these wires were soldered. He denied that he had any prejudice against electrically-driven pumps. In fact, he was rather in favour of them; they were very convenient. Altogether the plant broke down four times. On one occasion, in November, 1907, the temperature below ground rose to 210°, and they had to shut down the plant for a time in order to allow things to cool. Witness could not say much about the temperature of the motor, because that part of the plant was entirely in the hands of the electricians. Reports, however, were made daily concerning the motor. During the year ended March, 1909, he should say roughly they had brought about 1,000 tons of ore to the surface. They had sold, he should think, about £500 worth, but 120 tons of that, comprising arsenical ores, had been worked prior to March, 1908. The pump was working in March, 1908, and had been working since.

Questioned as to the need of an electrician to run the plant, WITNESS said that that they knew all through that they could not run the plant themselves, and as soon as it was handed over to them they intended to employ a qualified electrician to handle it.

Answering MR. RUSSELL, WITNESS said that the whole time since its erection the plant had been under the supervision of Crompton's men. On November 14th, owing to the trouble with the motor it had to be brought to the surface, and at one time there were four of Crompton's men attending to the plant. One of the men was called a rotor winder. Defendants' men would have the motor up out of the mine, make some alteration to it, and then, lowering it, endeavour to put it to work. Crompton's men had never suggested that the breakdowns were ever caused by the incompetence of witness's men in handling the plant.

MR. SAMUEL RICHARD TOMKIN, son of previous witness, said he acted as assistant to his father. No complaint had ever been made as to the incompetence of the plaintiffs' men working the plant. He corroborated his father's evidence as to the trouble experienced with breakdowns, &c.

MR. ERNEST MARTIN, one of the shaft attendants at the mine in question, gave similar evidence.

WILLIAM SANDOE, who was engaged to help Crossley's men in the erection of the gas plant, and who afterwards ran the gas engine under the supervision of Mr. Cragg, stated that they were

in the habit of starting the whole plant from the engine. Witness knew there was a triple-pole switch at the mouth of the mine for starting the motor, but to his knowledge it was never used. They started by speeding up the engine and generator. They had always had trouble with the governors of the engine, and they did not work properly now. Mr. Cragg had never complained that witness did not run the engine properly, and he was still employed at the mine doing so.

Cross-examined, WITNESS admitted he had never before had experience of gas engines until he was employed at the Wheal Busy mine. There had been complaints as to hot bearings up to three months ago, but that was through grit. At first they found that they had to make several attempts before they could get the generator to run in step with the motor. He could only keep the engine working irregularly at first, but there was no difficulty of that kind now. He found that if the engine worked irregularly, the temperature of the motor ran up. Sometimes the motor got out of step, but very seldom. During the last six months, the plant worked all right. He did not think that was because the engine drivers had learnt their business. For one thing, the governors of the engine had been altered by Garner.

Re-examined, the WITNESS stated that there was never any difficulty in connection with the water supply. The engine worked better since Mr. Garner did something to the couplings.

MR. GILBERT ROSENBUSCH, A.M.I.C.E., M.I.E.E., examined by MR. RUSSELL, said that in January of this year he had visited the mine in order to inspect the pumping sets, and measured the water that was being pumped. He had nothing to say about the producer plant, nor did he desire to criticise it. The engine, however, in his view was not satisfactory, and did not comply with the specification. The fly-wheels should have been three times the weight. The two together weighed about 3 tons, whereas to maintain the desired speed of the engine, and taking into consideration their diameter, they should weigh about 9 tons. This want of weight in fly-wheels made the engine run irregularly. There were two fly-wheels on the engine, overhanging the bearings, and the centre of the driving pulley, outside the fly-wheel, was some 2 ft. from the nearest support. The result of that was to bend the shaft and cause hot bearings and undue wear of the brasses. He examined the governor and found that it had been set so that it did not govern the speed of the engine. The fly-wheel of the engine was so very light that the governor was unable to prevent abnormal fluctuations in speed. The installation had been carried out most carelessly. The alternator was not a modern type of machine, such as that provided for in the specification, as it had a revolving armature and stationary fields. With a stationary armature there were no moving contacts to collect the main current, or brushes, and that was the reason why this type had been adopted especially for mines and works. There was also an absence of anything to prevent the oil from splashing on to the field windings. As to the exciter, in his opinion, the voltage was too low. It was only 40 volts. A proper voltage was 110. The connections between the alternator and the exciter were simply thrown in without any attempt to support them. The work was most temporary and unsafe, but fortunately nothing had happened. The ammeters were too large for the working current. There was no wattmeter, nor was there any means of telling what power was being taken. There was no starting switch for the motor. He had never heard of a motor of that size and type not having a suitable device for starting it. The fuses were so large that they did not give the protection they were intended to give, and the main cable leading from the switchboard to the motor had been hung in a most unsatisfactory way, and was carelessly installed. The insulation was rubber instead of bitumen, which was far better because it offered more protection against acid—and this mine was a tin mine. The motor was specified as "totally enclosed," but one of the difficulties of working with a machine of that description was the keeping down of the temperature. The means adopted to get rid of the heat in this particular motor was to make it not "totally" enclosed; that was, it had air pipes inserted to produce a passage of air through it, and thus ventilate it. The increase of load on the motor would tend to increase the heating. Witness proceeded at great detail to show the Court by calculation how, in his opinion, the motor was not sufficiently powerful. He took 65 per cent. as a fair value for the efficiency of the pump, and calculated the required output of the motor at 71·5 H.P. Taking the actual current in amperes and volts, he concluded that theoretically the pump ought to have lifted 500 gallons per minute, which was, of course, but half the amount specified. Most of these plants were designed with the engine horse-power three times more than that calculated to be actually expended on the work. The engine which had been installed would never have kept the pump running, even if the pump had lifted the 1,000 gallons specified. Therefore, even if the plant had been up to the specification, it would not have done the duty required of it.

Questioned as to the clearance of the air gap between the stator and the rotor of the motor from ·03 to ·05 in., WITNESS said that such an alteration would have a very marked effect upon the efficiency of the motor. It would decrease the power factor enormously, but it would permit the motor to start somewhat more easily. The greater the space between the stator and the rotor, the greater the necessary magnetising current, and the greater the loss of power. The jamming of the rotor against the stator when the current was turned into the machine, proved that the shaft was too light. There ought to be no alteration in the position of the rotor when the current was put into the machine, especially in vertical spindle motors where there was not the weight of the shaft to be considered. In the machine in question, witness noticed that the shaft was much lighter, and the bearings much smaller than was usual with motors of that size. With regard to the turning of the rotor rings mentioned by a previous witness, Mr. Rosenbusch said that as far as he could make out, resisters were introduced into the motor windings so as to facilitate starting.

Cross-examined by MR. ABEL THOMAS, WITNESS said that the engine, one of Messrs. Crossley's ordinary types, was hopelessly wrong for this kind of work, which required constant speed.

Can you give any specific instance where a gas engine of 71 H.P. has a fly-wheel weighing 9 tons?—Witness admitted that he could not.

Further cross-examined, WITNESS said that the oil was carried over by the belt from the engine to the dynamo, and thus caused considerable difficulty in keeping the fields and armature clean.

WITNESS said that to start the motor directly on the line was a very inadvisable method. As to the amperemeter, it would depend upon the amount of the starting current whether or no a smaller meter would indicate properly. When he was at the mine the motor was at work pumping, so that he could not thoroughly examine it, but from its size and speed he should judge it to be a 50-H.P. machine.

Is a 55-H.P. motor sufficient to raise water to a head of 120 ft., including friction—that is, 110 ft. plus 10 ft. friction?—Yes.

The motor ran from 8 a.m. until 2.30 p.m. on a varied load of 73 amperes per phase at 495 volts, or 70 B H.P. It was stopped for a few minutes to make some changes, and then ran on until 4 o'clock on a load of 86 amperes, 517 volts, or 87·6 H.P. It was overloaded 27 per cent. during the first 6½ hours' run, and 56 per cent. during the last 1½ hours. That is a strong test to make, is it not?—WITNESS admitted that it was.

In answer to COUNSEL, WITNESS said that under such a test as that he should expect the temperature of the motor to rise to over 200° F.

COUNSEL: It was 250° F.

WITNESS: More than boiling water. I should never want to subject a motor to such a test. That was over-testing it.

MR. THOMAS: You say that a rise of 72° F. is as much as you would subject it to?—Yes, that is the standard specification of to-day.

With regard to the windings of the stator, what caused those to be burnt out primarily, that is, before the bars in the rotor?—I think that what caused that was that the shaft was not stiff enough; that the rotor mechanically rubbed the stator, produced heat there, and burnt out.

Will you tell me what was the thickness of the shaft?—It is apparently 3 in. in the rotor.

What is the distance between the bearings?—I am unable to say.

As I understand it, it is of no use having that 3 in. unless you also have the distance between the bearings?—I say the shaft was not thick enough originally because I was told the rotor did actually touch the stator.

From that you come to the conclusion that the shaft was not thick enough?—Either that or the air-gap too small.

What was the air-gap?—Somebody spoke about three thousandths of an inch; I think he must have meant three hundreths.

Do you mean to say that you do not know what the air-gap was? What have you taken to be the air-gap in this particular motor?—·75 of a millimetre.

Then you have assumed that the air-gap was twenty thousandth of an inch?—About that.

Would you be surprised to hear that it was certainly $\frac{15}{1000}$ths?—Yes.

It is possible, is it not, if the engine were not working properly, that there would be a pulling out of step?—Witness admitted that the motor might pull out of step and cause short-circuiting and burning of the bars.

Supposing some of the bars were burnt, what would be the effect on the magnetic pull?—There would be more pull at one place than another.

When the rotor is perpendicular or upright, what is to bring it against the stator unless you have a "burn-out?"—A worn bearing or a bearing out of line.

What bearing was it in such a condition on this motor?—The one I saw—the ball bearing.

Have you ever heard that it did wear?—Yes, one letter states that it was so.

Witness said that in this particular machine there was a third bearing, which, he understood, had been put in afterwards; that would enormously help the top end of the shaft, but it would not affect the bottom end.

COUNSEL: Would that third bearing make the shaft stiff?—It would help it. Witness said he would have used solid bearings. That was the standard practice. The conclusion he had come to was that where there were two ball bearings, that did not tend to keep a rigid shaft and that a solid bearing kept it more rigid. The ball bearings would cause the shaft to deflect sufficiently to allow the rotor to hit the stator. With regard to the suction of the pump affecting the running of the motor, witness said that with a proper motor, if the suction were kept within reasonable limits, it would not affect the power required.

Asked whether it was usual to specify the nature of the water to be pumped, WITNESS said that pump makers invariably requested the information, because not only the amount of material in the water affected the pumps, but the nature of the water, viz, whether it were acid or alkaline. These pumps worked with a very small clearance, and dirt or metallic particles had a very large effect upon them.

MR. ABEL THOMAS: You have said that the overall efficiency of machines of this sort, motor pump, and so on, is not much more than 30 per cent?—I said one-third; 30 or 40 per cent. under ordinary working conditions.

I suggest to you that no good maker would ever turn out such things, and that it is absolutely unheard of?—Witness again asserted that he was right, and mentioned a case at Dowlais where electrical plant had been passed which was losing 66 per cent. of its power.

Now, as to the temperature?—With an enclosed motor of the type at the mine, according to the German specification, the temperature might go up to 90° F. above atmosphere. That would be for cotton-wire insulation. Witness did not know the kind of insulation on the motor in question.

Further questioned on the subject of temperatures, WITNESS explained that in a place such as a mine where a motor had to work continuously, and could not receive the attention it would have in an engine-house, it was policy for engineers and contractors to rate such motors as conservatively as possible, in order to keep the temperature down. For this reason squirrel-cage induction motors were often rated at 40° C., and he could give instances where they were rated at 35° C.

Re-examined by MR. SCHILLER: WITNESS put in specifications from various electrical engineering firms and electrical undertakings in support of his evidence as to the rise of temperature allowed under certain working conditions.

MR. SCHILLER: In the conditions at the Wheal Busy mine, what was there which tended to reduce the efficiency of the pump?—That pump was made for 120 ft. total head, but it had to work if dropped to that depth to a much larger head, because of the friction. In this case the friction was unusually high, because the 7-in. pipe which was being used was much too small for 1,000 gallons a minute. The standard practice of hydraulic engineers, concluded witness, gave a speed of about 6 ft. a second in pipes. In the pipe used it was 10 ft, consequently the loss in friction was abnormal. It was for that reason that he calculated the efficiency of this particular pump at only 65 per cent.

Answering further questions with regard to the weight of the fly-wheels of the gas engine, &c., WITNESS said that if the fly-wheels were too light the speed of the engine fluctuated before the governor could act, with the result that a see-sawing motion was set up. The motor speed then see-sawed also, with the result that the pump worked irregularly, and if this fluctuation got sufficient it would pull the machinery out of step. The conditions at the mine were not ideal for the pump, nor was the water pure. In his opinion the pump ought to be slower speed and multi-stage instead of high speed and single stage.

MR. SCHILLER: Having seen the plant and its work, and having made experiments with it, do you think that motor and pump would ever deliver 1,000 gallons per minute from a depth of 120 ft.?—Never, it does not do it at 100 ft. depth. There is about 500 gallons being delivered now with the engine speed up to its maximum and everything running normally.

Evidence of MR. GARNER, plaintiffs' electrical engineer, which had been taken on commission, was then put in, and counsel announced that that concluded the plaintiffs' case.

(To be continued.)

AMALGAMATED RADIO-TELEGRAPH CO., LTD.

THIS matter came before the Court of Appeal, consisting of the Master of the Rolls and Lords Justices Buckley and Kennedy, on Saturday, upon the appeal of the liquidator of the company from a decision of Mr. Justice Neville in the Chancery Division. At the conclusion of the arguments of counsel, the Master of the Rolls, in giving judgment, said he thought the decision of Mr. Justice Neville was right, and his order should be affirmed with this variation that the liquidator should be entitled to raise any defence he might have under the Statute of Frauds. Lord Justice Buckley thought that appeal ought to be allowed, and the order of the learned judge discharged. Lord Justice Kennedy agreed with the judgment of the Master of the Rolls, and by a majority of the Court, therefore, the appeal was, subject to the variation of the order as stated, dismissed.

"Z" ELECTRIC LAMP MANUFACTURING CO., LTD., *v.* ZCSSENHEIM.

IN the Chancery Division on Saturday (May 8th) this action came before Mr. Justice Warrington on a formal motion by Mr. Morrits on behalf of the plaintiffs for judgment in default of defence. Defendant did not appear.

His LORDSHIP gave judgment according to minutes.

TELEGRAPH CONSTRUCTION AND MAINTENANCE CO., LTD., *v.* MERCHANT & CO. AND AARON COHEN & CO.

THIS action, arising out of a robbery of gutta-percha from the plaintiffs, was opened last week in the King's Bench Division, before Mr. Justice Lawrance and a special jury. Mr. Shearman, K.C., and Mr. Disturnal were for the plaintiffs; Mr. Rufus Isaacs, K.C., and Mr. J. R. Atkin, K.C., and Mr. R. B. Murphy for defendants Cohen; and Mr. Spencer Bower, K.C., and Mr. Blackwell for Merchant & Co.

MR. SHEARMAN said that plaintiffs used in the manufacture of telegraph cables a large quantity of gutta-percha. The claim was by plaintiffs against both the firms mentioned in regard to large quantities of gutta-percha, which was stolen from plaintiffs and found its way first to Merchant & Co., and then to Messrs. Cohen and Co., the latter being the substantial firm in the matter. Between the years 1905 and 1908 serious thefts of gutta-percha took place from plaintiffs' works, and it was traced to a small shop kept by Merchant & Co., who sold some of it to Messrs. Cohen and Co. In connection with this a man named Boniface and several of plaintiffs' workmen were prosecuted, and Boniface got 18 months' imprisonment. The main issue the jury had to deal with would be the question of the value of the gutta, as Messrs. Cohen had frankly admitted that a portion of the goods in question belonged to the plaintiff, but denied that the value of the goods was as stated by plaintiff, viz., about 4s. per pound. A great deal of evidence was given, the first witness for the plaintiffs being Mr. W. P. Granville, assistant manager of the plaintiff's works.

CHAS. BONIFACE, who was brought into Court by two prison warders, said he was in the employ of plaintiffs for 19 years up to two years ago. During the years from 1905 to 1908 several men used to bring witness soft gutta, and he immediately disfigured it, and sold it to Merchant & Co., which was a private house. He did not know Merchant & Co., but saw a man named Jewell there (Jewell stood forward in Court, and witness identified him). The men from plaintiffs used to bring the gutta to him three times a day; sometimes his wife took it in. Merchants used to send a carman to witness's house for the stuff. He got 9d. per lb. for it.

Cross-examined by MR. BOWER: It was about four or five years ago that he first began to steal, but the men used to do it themselves before he started.

CHAS. ALLEN, chief clerk to plaintiffs, said he had inspected some entries in Messrs. Cohen's books relating to dealings with Merchant & Co., Dick & Co., Harborough Rubber Co., McLeod and Co. and a French firm (Haree & Co.). These figures were put in. Witness gave a number of figures as to the value of the gutta, and said a sample was made up of the goods returned from Cohen's and Dick's and submitted to a German firm, the result being an order for 2 tons at 5s. 1d. per lb.

Cross-examined by MR. ISAACS: The figures he had given were based on the selling price, and, of course, included the profit. It was very difficult to arrive at the average value of the material they recovered. He was not a gutta-percha expert.—Re-examined: The selling value of the bulk of the goods was about 5s. per lb. ready for sale.

MR. W. PLENDER, chartered accountant to the plaintiff firm, produced figures showing the value of the goods.

For the defendants, MR. ISAACS said he took the point that his learned friend had not established by any evidence against Cohen and Co. that they received £1 more than they said they received and accounted for. The question of value was, of course, in dispute.

MR. BOWER, for the defendants, Merchant & Co., said Mr. Merchant was dead, and his widow represented the firm. Of course, it was very hard on her that buying gutta, as she believed honestly, she should have to pay again its value. But she ought not to be made to pay more than the actual value.

MR. ISAACS, for Messrs. Cohen, said the point which the jury had to decide was to his clients very important. They were a firm who had been in business for over 100 years, and were highly respected in the trade, and in all that time no question of this kind had ever happened before. Immediately this matter arose, Messrs. Cohen offered to give back to plaintiffs all they had and to pay for what they had sold. The real question at issue between the parties was what was the real value of the gutta at the time it came into the possession of Messrs. Cohen, and that the jury would have to determine. He laid great stress on the fact that no single expert had been called by the plaintiffs to support their claim as to the value of the gutta.

On Monday the hearing was resumed, and a great deal of additional evidence was given.

Eventually the jury found a verdict for the plaintiff, estimating the price of the the 207 cwt. at 3s. 6d. per pound—a total of £4,057 4s. Judgment was given accordingly, with costs.

CLAIMS AGAINST THE MANX ELECTRIC RAILWAY CO.

FURTHER claims by passengers who were injured in the collision of last September were considered last week, and judgments for £115 10s. and £60 respectively were given.

SEEBOLD *v.* PAGE & MILES, LTD.

(Continued from page 754.)

IN the High Courts on Thursday, May 6th, Mr. Justice Bucknill, sitting in the King's Bench Division, renewed the hearing of this action.

CAPT. SANKEY, an expert, continuing to give evidence for the defence, said that, in his opinion, there was nothing to show that the plant had been badly installed, but it had not been properly looked after. On examining the dynamo, he found the field magnets were in a dirty condition. With regard to the question as to whether the 7-in. belt was wide enough, witness said, in his opinion, there was ½ in. to spare. He did not agree with the suggestion that the narrowness of the belt had necessitated such a high tension that the armature spindle of the dynamo had been pulled sideways owing to the wearing of the bushes. In the plaintiff's design, there was no iron silencer at all. The pits were the silencer.

MR. GEORGE PHILLIPS, the local manager of the defendants at Worthing, recalled and further cross-examined by MR. LOW, said that the suggestion to have the pits was made by the National Co.

Mr. George Clements, examined, said he was employed by Messrs. Crompton's, electrical engineers, of Chelmsford. He remembered the armature of the dynamo being returned to his firm in July. The cause of the breakdown was filth and dirt. In his opinion the machine had not been properly attended to.

Mr. John Windeb, examined, said he was foreman of the defendant firm, and that he took charge of the plant for three weeks, Sundays included, and then handed it over. When the trouble arose, he went and inspected it, and formed the opinion that the breakdown was caused through neglect on the part of the man in charge of the plant.

Mr. Edward Anderton, examined, said he was London manager of the National Gas Engine Co.; the way the engine was placed was his suggestion, and the pit was also his original suggestion. In his opinion, the plant was properly installed.

The matter was before the Court again on May 11th when further evidence was given on behalf of defendants. Counsel agreed not to address his Lordship on behalf of their respective clients, and his Lordship intimated that he would consider his position.

PARLIAMENTARY.

North-West London Railway.

On Wednesday, May 5th, the Select Committee of the House of Commons, of which Sir R. Compton-Rickett is chairman, commenced the consideration of the North-West London Railway Bill. Mr. Balfour Browne, K.C., appeared for the promoters, and petitioners against the Bill are, among others, the Great Western Railway and National Telephone Co.

Mr. Balfour Browne, in explaining the provisions of the Bill, said that the promoters were asking powers for an extension of time for the construction of a tube railway for which Parliamentary sanction had already been obtained, between Cricklewood and Edgware Road, and to abandon the remainder of the authorised line from Edgware Road to Victoria. It was now proposed to make a junction at Edgware Road with the Baker Street and Waterloo Railway. They would also make an exchange station at Charing Cross, which would enable the public to get to Victoria. They had come to an agreement with the Baker Street and Waterloo Co. for them to work the line. The promoters of the railway were the British Electric Traction Co., who controlled about 50 tramways, which operated 390 miles of lines. They also had lines of omnibuses running over 40 miles. The capital of that company was £4,000,000 authorised, and the shares stood at a considerable premium. There was no doubt that the British Electric Traction Co. was a strong financial undertaking. The original promoters of the scheme were the Brush Electrical Engineering Co., and they proposed to run from Victoria to Cricklewood, about seven miles. By the scheme now before the Committee they proposed to abandon that part of the line which ran from Edgware to Victoria, and in substitution of that they had entered into an agreement with the Bakerloo, whereby a connection was made at Edgware Road, and the trains were taken through to the Elephant and Castle. They were supported by all the local authorities. When they obtained their Act in 1896 a clause was inserted in the Bill giving the Board of Trade, on the application of the L.C.C., power to declare the powers under the Bill void, if the works had not been substantially commenced within two years of the passing of the Act. Although, of course, it was over two years since their Bill passed, no application had been made to the Board of Trade. The line would meet a public requirement. At the Cricklewood end they met the tramways of the Middlesex County Council; at Edgware Road they had the Metropolitan Railways; they had an exchange station at Regent Circus with the Baker Street and Waterloo Railway; they caught the Brompton Railway at Trafalgar Square; at Charing Cross they met the District and the Metropolitan Railways; and then they joined the South-Western Railway at Waterloo, and last of all, at the Elephant and Castle they had an important junction of tramways. He was going to call the manager of the Brighton Railway, who would speak in favour of the scheme. To some extent the Bill was a departure from what was proposed in 1896, yet there still existed a public necessity for it. The scheme as originally proposed provided for the raising of £3,000,000, but now by the abandonment of part of it and the arrangement which they had come to with the Bakerloo to work the system, they would only require £1,200,000. Of course, it was easier to raise a smaller amount of capital, for though Parliament might pass Bills, the City could reject them. They estimated the receipts from the line to Brondesbury to produce £96,000, and the expenses at £52,000, showing a net receipt of £44,000.

Local evidence was then given in support of the scheme.

On May 6th, Mr. E. Garcke, managing director of the British Electric Traction Co. and the Metropolitan Tramways Co., gave evidence. He said that about a year ago the Brush Electrical Engineering Co., who were the original promoters, took the scheme to the B.E.T. with a view of raising the necessary capital. His company had no difficulty in satisfying themselves that there was a general demand for the line, and more especially that there was a desire among the North London people for the railway. When they examined the scheme carefully, however, they found that the conditions had materially changed since 1896. At the present moment there was £72,000,000 invested in tube railways, but that figure did not include the debentures. On that large sum the return was very small. He did not think it would be possible to raise capital for a scheme which was wholly and solely a tube railway. In the case now before the Committee, the conditions were different, inasmuch as they proposed to enter into a working agreement with the Bakerloo. It was absolutely impossible for the ordinary investor to put his money into tube railways, having regard to the experience of the other lines. When they considered the railway as originally passed for running from Cricklewood to Victoria, they found it would be absolutely impossible to raise the necessary capital.

The Chairman remarked that in the case of the Metropolitan and District they already had their traffic, but the tube railways had to create it.

Witness, continuing, said that the average return on the money invested in the tube railways was ½ per cent. That also included the railways which had been converted for electrical working. When the scheme was before Parliament in 1896, it was estimated that there would be 36,000,000 passengers: the average fare 2d., and the proportion of expenses to the receipts 50 per cent. He had considered those estimates, but he differed from the last two. He thought the average receipts were estimated too high, and the proportion of expenses was too sanguine in his opinion. Last May they ran an experimental line of omnibuses from Cricklewood to Victoria to see what traffic they could expect, but the results were not satisfactory. They then ran a service from Cricklewood to Waterloo, and the results were very satisfactory. He considered that the line could not be a financial success if it depended on its own traffic. He had seen Sir George Gibb, and a provisional agreement had been made with the Baker Street and Waterloo Co., which was in perpetuity. They had made a formula which provided how the receipts would be distributed. Under that agreement the proportion of the receipts which would go to the North-West London Co. depended upon the profits which they made on their own line. For instance, if they made no profit they would receive 75 per cent. of the contributed receipts; if they made 1d. per car-mile, they would get 66 per cent.; 2d. per car-mile, 55 per cent., and so on in proportion, until, if they made 5d. they would only get 10 per cent. of the contributed receipts. They had power under the Bill to raise £1,200,000, of which £400,000 could be in debentures. They had not yet decided how much would be in debentures. At present they only proposed to run to Brondesbury, and that would cost £600,000. His company would find the money required for the construction, and also take the deferred ordinary shares. They were advised that there would be no difficulties in raising the preferred ordinary and the debentures. They estimated the receipts from the line, so far as to Brondesbury, at £45,000 in the first year, and that would give approximately a return of 5 per cent. on the whole of the capital required to be expended on the line. The gross receipts on their North-West extension were estimated at £70,000, and that would be supplemented by the contributed receipts from the Bakerloo, which would bring the figure up to £100,000. The Metropolitan Tramway Co. were prepared to bring the trams down to the Brondesbury station before the tube was opened, but they would have to get Parliamentary powers to do so. He estimated the local traffic on the North-West line as 75 per cent. of the local traffic of the Bakerloo. The estimates were based on an average fare of 1½d. They had made it a condition with the Baker Street and Waterloo Co. that they should give them all the trains which they wanted. He thought he would want a closer service than a 5-minute one.

Replying to the Chairman, Mr. Garcke said his calculations were based on a 2½-minute service.

Continuing, Witness said he did not think that the promoters ought to be burdened with undue restrictions.

The Chairman: It is the Bill, the whole Bill, and nothing but the Bill.

Witness: No, sir; we do not mind anything reasonable and within the limits of our estimates, but no exceptional burdens.

Mr. Clode cross-examined on behalf of the Metropolitan Railway, and witness said that this concession would now become one of the assets of the British Electric Traction Co. He had his doubts whether the line from Edgware Road to Victoria would ever be constructed. His company would make itself responsible for the raising of the £400,000 required to start the undertaking. One effect of the agreement with the Bakerloo was that that company could not make a through line to Paddington.

Sir Charles Rivers Wilson, chairman of the B.E.T., corroborated Mr. Garcke's evidence.

In answer to Mr. Lloyd, K.C., who pressed witness as to who were the actual promoters of the Bill, Sir Charles said that the North-West London Co. was controlled by the Brush Co., and the Brush Co. was controlled by the B.E.T.

Counsel: Isn't it a fact that the North-West London Co. is a mere shadow?—You say so.

But isn't it a fact?—No answer was given.

Mr. Cecil Braithwaite also gave financial evidence, and said that in his opinion the money would be raised without difficulty.

Mr. R. J. Howley, M.I.C.E., spoke as to the details of how the estimates were made up.

Mr. R. J. Howley continuing his evidence on Friday, said they had estimated the total annual receipts on the line as £96,187, made up as follows: Traffic receipts £66.964, advertising £4,000, and the contribution from the Bakerloo £25,233. On the other side the total expenses were estimated at £52,016, which left a balance of £44,171 on the year's working. The working expenses of the two companies would be pooled.

Mr. Clode cross-examined Witness on behalf of the Metropolitan Railway, and in answer to counsel Witness said he estimated that the number of passengers would be 13,300,000. The average fare 1½d., which was equal to £29,115 per mile, and per mile per passenger the average would be nearly a 1d.

Mr. C. H. Dade, secretary to the B.E.T. Co., gave evidence as

to the minutes of the board meetings at which it was decided to support the scheme.

Mr. Clode cross-examined Witness at length as to who the North-West London Co. was actually composed of, and who were the directors.

Mr. Dade maintained that the Brush Engineering Co. acquired the controlling interest in the North-West Co., and the B.E.T. had the controlling interest in the Brush undertaking.

Mr. W. B. Parsons, engineer, designer and constructor of the underground electric system of New York, and a director of the Underground Electric Railways Co. of London, stated that it was unquestionably desirable that the line should be constructed. He did not think there would be any difficulty in working a "shuttle" train from the Edgware Road Station of the Bakerloo Railway to the Paddington Station of the Great Western Railway. He thought that if the train service went to the Great Western Station, the North-West line would lose more than half of its traffic. It was essential to the success of the system that there should be a rapid and continuous service of through trains. It was the experience of tube railways that they could not live by abstracting traffic from other railways—they had to develop a traffic of their own. They anticipated that such would be the case in this instance.

At the commencement of the proceedings on Monday the Chairman said he wanted to ask if any evidence could be given as to whether the line to Victoria could be made at any future date, and if it could be made confluent with the scheme now before the Committee. Also, they would like to know what efforts had been made by the promoters to raise the capital, and how far their efforts had met with success. They wanted, further, to know more about the cost of constructing the line, as the statements made when the Bill was last before the Committee, and the evidence now given, were not reconcilable.

Sir George Gibb, deputy-chairman of the Underground Electric Railways, and chairman of several other tube railways, said that in July last Mr. Garcke asked him whether the Bakerloo Co. would look favourably on the line as now proposed being constructed. His company had not done anything further with the powers authorising them to run their line into Paddington Station. They thought it was better to make a termini which could be carried further on if the necessities of the traffic warranted it, rather than make a termini for all time. He thought a shuttle service could be worked from the Edgware Road Station to Paddington. He thought a confluent junction would be a nuisance. He believed that the Bakerloo could work a 1½-minute service. They would allow a service on the Bakerloo so that the whole of the trains could be run on the North-West line. He considered that the Great Western Railway should pay something towards the cost of constructing the line to Paddington.

The Chairman: Your case is that "shuttle" or any service would not pay you if you had to bear the whole of the cost of constructing the extension?—Witness: I think so.

Continuing, Sir George said that the agreement between the two companies was, in his opinion, a favourable one for the North-West Co. The Bakerloo would supply the electric current. Any cases of dispute were to be settled by arbitration.

Mr. Clode, in cross-examining witness, read to him the extract of the report of the Royal Traffic Commission, of which Sir George Gibb was a member. Counsel pointed out that in the report it was stated that it would be a great advantage if at some future time there were north and south communications to and from Victoria, and that there should be a subway connection at Hyde Park, so as to allow of the interchange of east and west traffic.

Witness said he signed that report, but he believed the scheme now proposed was a better one, and he did not think that the capital for the Victoria proposal could be raised.

Counsel: Has this abandonment of the Victoria scheme a further advantage to you, as it gets rid of a competitor to the Bakerloo, and also the District Railway?

Witness: Of course it gets rid of a competitor.

Continuing, Sir George said that the cost of constructing tube railways ran between £620,000 and £743,000 per mile. He did not agree with the average fare of 1¼d. per passenger as stated by Mr. Garcke. He thought it would be 1·16d. That figure compared with the Bakerloo, 1·48d.; Great Northern, Piccadilly, 1·94d.; Charing Cross, 1·66d.; and the Great Northern and City, 1·54d.

Sir George Gibb, continuing his evidence on Tuesday, said that the recommendation of the Traffic Commission as to the construction of a line from Victoria to the north-west had reference to "some future time." He was in favour of a tramway in a shallow subway under the eastern side of Hyde Park from Edgware to Victoria. He did not think the Victoria line could pay. There would be less chance of it being remunerative if there was no through service. To have an exchange station at Edgware Road would seriously affect the traffic on the line. He considered that there were strong financial difficulties which affected the Victoria project, but they did not arise in the scheme now proposed. Should the Great Western Railway contribute towards the cost of a shuttle service from Edgware Road to Paddington Station, every possible facility would be afforded by an exchange station. As to the suggestion for a confluent junction in a tube railway, it was better to have exchange stations. The congestion of traffic on the District Railway in consequence of confluent junctions had been most extreme.

Mr. A. H. Stanley, general manager of the Bakerloo and other underground railways, said that his experience was that a main line terminus did not provide a good gathering ground for a local line. His experiences of the difficulties of confluent junctions led him to prefer exchange stations. There would be no difficulty in working a shuttle train on a single line which would run between two platforms, the doors opening both sides.

Mr. W. L. T. Brownn, of Kilburn, spoke in favour of the scheme.

Mr. E. Garcke was recalled to prove that efforts had been made to raise money for the 1906 scheme. He said that a large body of influential financiers met together to consider whether the money could be raised, but it was found that the statements made before the Committee in 1906 could not be substantiated. The scheme was too large to put on the market, considering the state of the financial world. They had endeavoured to get local support, but they had failed. They came to the conclusion, therefore, that the scheme would have to be modified.

North Metropolitan Electric Supply Bill.

On Friday, the Select Committee of the House of Lords, presided over by Lord Ludlow, considered the Bill promoted by the North Metropolitan Electric Supply Co. Among other things, the company is asking powers to raise £250,000 additional capital and to raise the whole of its unissued capital as preference shares. Mr. Freeman, K.C., represented the West Ham Corporation, petitioners against the clause giving the company power to supply energy to 15 railway companies for the purpose of illuminating stations.

Mr. J. F. Gooday, general manager of the Great Eastern Railway, gave evidence and said that his company thought that power should be given to an electrical company for supplying railways with energy for both lighting and haulage. He wanted to make it clear that his company did not, at the present moment, intend to take a supply from the promoters. He was not in favour of municipal enterprise, but he would not oppose the West Ham Corporation having the powers.

Mr. J. Devonshire, managing director of the North Metropolitan Co., gave evidence and referred to the difficulties under which the company laboured through not being able to give a supply for both lighting and haulage. They could supply energy for lighting the carriages but not for illuminating the stations, and that was what they wanted.

This closed the case for the promoters.

Mr. Morten called Mr. Seabrook, electrical engineer to the West Ham Corporation, who said that the Corporation had expended £400,000 on their undertaking, and there was room for further extension. Since he had been engineer to the Corporation many Bills had been promoted, and attempts made to compete with them, but they had all been unsuccessful. The words in the clause were "authorised users," and that would include the Lea Navigation Co. and the Lea Conservancy Board—the promoters were asking for a general law.

Mr. Freeman, K.C., in addressing the Committee, said that West Ham had been authorised by Parliament as the responsible authority for the supply of electricity, and he did not see why this body should be allowed to compete with them, subject only to the cumbersome and lengthy proceedings before the Board of Trade. The promoters had twice asked powers to remove the restrictions, and on both occasions they had failed, and he asked that they should not be given the power now.

The Committee, without calling upon Mr. Browne to reply, unanimously allowed the Bill to proceed.

Oldham Corporation Bill.

After over a fortnight's consideration of the water and gas clauses of the above Bill, the Select Committee of the House of Commons, presided over by Sir F. Leyland Barrett, reached the tramways and electricity clauses.

Mr. Alderman Dunkerley (chairman of the Tramways Committee), who was called by Mr. Weddeburn, said that the Corporation acquired the horse tramways in the borough in 1899, and had since electrified them and added to the system. Subsequently they took over tramways to Royton, Crompton and Lees. The present system covered 25½ miles. It was now proposed to construct five additional lines. Three were short lines in the centre of the town, to link up the system and prevent congestion, one was for an extension from Rippenden Road to Grains, and the other would enable them to join up with the Chadderton system when constructed. For the last three years the tramway profits had been £7,284, £9,326 and £9,010 respectively.

Mr. Slattery (general manager of the tramways) gave corroborative evidence.

Mr. E. C. Foote, surveyor and engineer to the Corporation, produced plans of the proposed lines, which, he said, presented no engineering difficulties. The estimated cost of the lines was £19,600 and of the nine waiting rooms £2,550.

There was no opposition to the proposals.

A clause was inserted to protect the National Telephone Co., and a clause was also agreed to, to enable the Corporation to run motors within the borough.

Clause 31 of the Bill, which was to enable the Corporation to run tramcars on the trackless trolley system, was by agreement omitted.

Mr. Greves next opened the electricity part of the Bill, which was dealt with in Clauses 44, 45 and 46. What the Corporation asked for was, first, that where individual consumers or would-be consumers were unable to get a supply of electricity, they might by arrangement with the Corporation and subject to the consent of the Board of Trade, be supplied by the Corporation. Secondly,

it was asked that the Corporation might take over the transfer of any order which adjoining districts might obtain. Thirdly, they asked that the Corporation might enter into arrangements for the supply of electricity in bulk with anyone who was authorised within the districts of Chadderton, Royton, Crompton, Lees and Limehurst, which districts, with the exception of a small piece of Limehurst were all within the gas and water limits of the Corporation. The output of electricity by the Corporation last year was 5,271,000 units. At the present time the position of affairs was that the borough boundary ran down the centre of some roads, and whereas the people on one side of the street were supplied by the Corporation with electricity, those on the other side could not get a supply, and the Lancashire Electric Power Co. objected to the Corporation supplying. The nearest supply of the Lancashire Electric Power Co., however, was 7½ miles away from where the Corporation sought to supply, and if Parliament upheld the contention of the company, it must give them a monopoly over a large portion of Lancashire.

Other evidence having been called, Mr. Clode addressed the Committee on behalf of the Lancashire Power Co. He contended that that company had been entrusted with the authority of supplying Lancashire, and if they failed to do so, it was open for Oldham to go to the Board of Trade, and his clients would be punished.

Mr. C. D. Taite, general manager of the Lancashire Electric Power Co., said he was prepared to quote a price for the supply of the district outside Oldham.

On Tuesday the Committee passed the electricity clauses.

Torquay and Paignton Tramways.—It has been ordered that the resolution of the Standing Orders Committee of March 25th with respect to the above Bill shall be referred back to the Committee with power to inquire whether there are any special circumstances which render it just and expedient that the Standing Orders shall be dispensed with.

Cable to Clare Island.—Replying in the Parliamentary Papers to Dr. Ambrose, Mr. Sydney Buxton states that he hopes the cable ships will be in Irish waters in about six weeks' time, and it will be possible then to lay the Clare Island cable.

Third Reading.—In the House of Commons on May 7th the York Town and Blackwater Co.'s (Electric Lighting, &c.) Bill was read a third time.

Gravesend and Northfleet Electric Tramways.—The Gas and Water Order Bill (No. 1), which confirms a Local Government Board Order enabling the Gravesend and Milton Water Co. to carry out new works, contains a clause for the protection of the tramways of the Gravesend and Northfleet Electric Tramways Co., Ltd, which provides that except in the case of sudden emergencies the undertakers shall give seven days' notice to the company of any intention to sink a trench within 4 ft. 6 in. of the tramway rails; that the Tramway Co. shall be entitled to superintend the work; and that any question which may arise shall be settled by arbitration.

Wallasey Tramways and Improvement Bill.—On Friday and Monday the Select Committee of the House of Lords, presided over by Lord Ludlow, considered the Bill promoted by the Wallasey U.D.C., which sought authority for the construction of tramways. The estimate for the tramway construction amounted to £41,483, and £10,627 was put down for posts, standards, &c. There was no opposition to the tramway portion of the Bill, which went through.

BUSINESS NOTES.

Book Notices.—*The City of London Directory*, 1909 London: W. H. & L. Collingridge. 12s. 6d.—This directory is doubtless already well known to many of our readers. It appears a few months later than some other works of reference in order to include the numerous trade changes that generally take place in the first quarter of the year. Its lists of Corporation and L.C.C. members and officers, and its particulars of the various city companies, are useful, but its alphabetical, street, and trade sections, also its large map, are the things more in demand in the average business office. It is strongly bound in a colour all its own by which one can readily pick it out from among other reference books, we had almost said blindfolded.

International Electrotechnical Commission: Transactions of the Council, October, 1908. London: From the General Secretary.—This report contains, in French and English, a detailed account of the Council meeting of the Commission, with a portrait of the President, Prof. Elihu Thomson, and a portrait group of the delegates. Although the actual work accomplished was limited to the passing of a few resolutions, it is claimed that these resolutions have laid the foundations of future work of great utility to the electrical industry.

We are informed by the General Secretary, Mr. C. le Maistre, that thanks to the efforts of Signor Guido Semenza, of Milan, the Italian Electrical Society has now decided to join in the work of the Commission, and is forming an Electrotechnical Committee, the President of which will probably be Prof. Luigi Lombardi, of the Technical School at Naples. An Electrotechnical Committee has now been formed in Belgium, with the assistance of the Government, the President being Prof. Eric Gérard, and the Secretary Monsieur L. Mittewic, the energetic secretary of the electrical section of the Chamber of Commerce; and a Brazilian Committee has been formed in Rio by the Brazilian Government under the presidency of Prof. H. Morize.

"Bulletin of Armour Institute of Technology." April, 1909. Chicago: The Institute.

"Ein neues System der elektrischen Fernphotographie." By Dr. R. Schönhöfer. Vienna: From the Author.

"Radio-Activity and Geology." By J. Joly. London: A. Constable & Co., Ltd. 1909. Price 7s. 6d. net.

"Physical Review," Vol. XXVIII, No. 4. April, 1909. London: MacMillan & Co.

"Journal of the American Society of Mechanical Engineers," Vol. XXXI, No. 5. May, 1909. Baltimore: The Society. Price $1.

"*Proceedings* of the American Society of Civil Engineers," Vol. XXXV, No. 4. April, 1909. New York: The Society.

Dissolutions and Liquidations.—The Auto-Claw Co., Ltd.—With reference to this company, whose liquidation has already been announced, Mr. James Todd, of 135, Wool Exchange, Basinghall Street, E.C., was on April 13th appointed receiver on behalf of the debenture-holders, and by a further order of the Court he has been appointed manager for the purpose of carrying on the business.

La Capital Tramways Co., Ltd., La Capital Traction and Electric Company, Buenos Ayres, Ltd., and the Buenos Ayres New Tramways Co., Ltd.—These companies are winding up voluntarily, with Mr. E. A. Lazarus and Mr. F. Thursby as liquidators.

Generators, Ltd.—This company is winding up voluntarily, with Mr. G. B. Murgatroyd, of Manchester, as liquidator.

Institute of Natural Therapeutics, medical electricians, 73, Queen Victoria Street, E.C., and B. Copson Garrett, 16, Finsbury Pavement, E.C.—Messrs. A. D., W., and A. W. Light have dissolved partnership.

Trade Announcements.—Mr. R. Charles Hall has established a drawing and tracing office at Gladstone House, Arundel Street, Strand, W.C.

Messrs. Oxley & Wilkinson have opened offices at 36, Spring Gardens and 35, Brown Street, Manchester, to carry on the business of electrical contractors. Price lists and catalogues from supply firms will be welcomed.

Messrs. T. Harding Churton & Co., of Leeds, have appointed Mr. David Alexander, M.I.E.E., of 43, Mains Street, Waterloo Street, Glasgow, as agent for Scotland for the sale of their alternating current motors.

We are informed that Mr. J. M. Bein, one of the partners, has bought the business of The E.M.F. Manufacturing Co., 10, Ironmonger Lane, Cheapside, E.C, and is carrying it on as usual.

The Telephone Instalment System Co., Ltd, 244, High Holborn, London, has been formed to facilitate the payment of the yearly subscriptions for telephones; the company undertakes to pay the subscription, the subscriber repaying it by instalments.

Fires.—A serious fire, as a consequence of which damage to the extent of about £20,000 was done, broke out in High Bridge, Newcastle-on-Tyne, on 7th inst. Several buildings were concerned, including the premises of the Simplex Conduits, Ltd.

A fire occurred on the premises of the Hart Accumulator Co., Ltd., at Stratford, on Tuesday afternoon. The cause is unknown. The reports appearing in the daily Press are greatly exaggerated, for the fire was confined to a part of the premises that was at the time unoccupied. We understand that the execution of contracts will be in no way interfered with.

British Trade in Russia.—The St. Petersburg correspondent of the *Times* states that the Council of the Russo-British Chamber of Commerce has appointed M. Timiriaseff, Minister of Commerce and Initiator of the Institution (who recently came to this country in order to promote increased trade between the two nations), as its first president. M. V. I. Savitzky was appointed managing secretary. At present the number of members of the Chamber exceeds 300. The institution of this Chamber has prompted the establishment of similar Russo-British organisations for the development of commerce between Russia and the Slav States, chiefly with the Balkans.

Holiday Guides.—The London and South-Western Railway has issued its official illustrated guide for the coming season, with a list of hotels, boarding houses and apartments.

The new "Tourist Guide to the Continent" has also been issued by the Great Eastern Railway publishers, 30, Fleet Street, E.C. (6d.). The book is illustrated, and it tells of new tours, *viâ* Holland, in North Germany, including the Harz Mountains and Thuringian Mountains, also in South Germany and Belgium. A series of useful maps is included.

New Zealand Tariffs.—The New Zealand Customs Authorities have recently given a decision to the effect that "electrical appliances, viz., holders, including handles for portable incandescent lamps," are to be classified under No. 190 of the Tariff, the import duty being 20 per cent. *ad valorem* on British goods and 30 per cent. in the case of foreign manufactures.

Bankruptcy Proceedings.—Walter Wardle, electrician, 14, Osborn Road, Levenshulme.—A supplemental dividend of 4½d. in the £ is payable at the office of the Official Receiver, Byrom Street, Manchester.

Catalogues and Lists.—MESSRS. W. GEIPEL & CO., Vulcan Works, S.E.—Leaflet relating to their Vulco joint-box compounds, in which they lay stress upon points that they consider should receive attention in choosing such materials.

C. W. HUNT CO., New York.—88-page illustrated catalogue of their coal and ore-handling machinery.

MESSRS. JULIUS SAX & CO., LTD., 100, Charing Cross Road, W.C.—Two new lists; one (No. 103) gives particulars with illustrations and prices of a number of adaptors for metal-filament lamps. Though primarily made as adaptors, a number of the articles can be used as cheap fittings when provided with cord grips, and in either case the weight of fitting and shade, &c., can be supported by a chain by utilising a stirrup. A special line of adaptors is listed for carrying a cluster of lamps under one shade. The other list (24 pages) is a catalogue of accessories for the "Facile" twin lead wiring system. It is stated that the system has now been extended so that by the use of special boxes, &c., a water-tight installation can be obtained. It is claimed that the wire can be run and points made with great facility, that the cutting away and making good in old buildings is much reduced, that the lead-covered cables can be easily bent to the contour of mouldings, that testing facilities (at junction boxes) are ample, that the system lends itself to future extensions, as the sub-main can be continued from the last joint-box, and that ordinary accessories can be used.

THE ELECTRIC AND ORDNANCE ACCESSORIES CO., LTD., Cheston Road, Aston, Birmingham.—A number of new catalogues, well produced and brought together in an expansible binder. Taking these in order as arranged, they deal with controllers for cranes, tramways, &c., motor-starters, "Autograd" self-motor-starters and panels, ironclad combined quick-break lever switch and fuses, D.C. motor-control panels, "Ordnance" propeller fans, and centrifugal or cased fans, carbon and metal-filament lamps, electric lighting accessories, cast-iron electric fittings, porcelain insulators, the Warner cut-meter, telephones and telephone accessories. Other sections are still in the press. The lists are uniform as to size and style of arrangement, they are all well illustrated, have tabulated sizes, code-words and prices, also dimension diagrams, and altogether they form a useful collection of lists of the firm's manufactures.

MR. G. BRAULIK, 8, Lambeth Hill, E.C.—New leaflet, No. 120, describing and giving prices of small lamp-holder and desk fans and small electric motors.

THE UNION ELECTRIC CO., LTD., Park Street, Southwark, S.E.—Small booklet attractively setting forth the virtues of the firm's "Fortiter" fans for office, shop and home cooling. Contractors can have a supply of the pamphlets printed with their own name if they apply at once.

MESSRS. ERCOLE MARELLI & CO., 26, Garlick Hill, E.C.—New 12-page price list of electric fans for the current season. Many different types for use in various positions are illustrated, sizes, weights, speeds, and so on, being tabulated.

HART ACCUMULATOR CO., LTD., Marshgate Lane, Stratford, E.—This is a well-arranged, and on the whole very neatly produced, catalogue of storage batteries of various types, the different sections being conveniently indicated by a thumb place opposite the titles of each on the index page. To indicate the ground covered, we may mention cells for lighting purposes, 25-volt batteries for metal-filament lamps, motor-car cells, central station cells, motor-car ignition batteries, portable batteries, also Hart patent sheet separators, spare parts, instruments, supply of acid, and shipping details. Prices, capacities, dimensions, weights, &c., are all clearly tabulated.

BRITISH INSULATED & HELSBY CABLES, LTD., Prescot. — New leaflets have been issued as follows:—P. 89, 90, 93, 94 and 95, all dealing with Prescot joint-boxes; P. 92, a lengthy list of electric tramway and railway contracts executed by the company.

MESSRS. SPAGNOLETTI, LTD., Goldhawk Road, W.—Leaflet No. 52A showing and stating prices of their "Easy Replacement" automatic cut-out which is intended to replace the ordinary fuseboard.

THE ARMORDUCT MANUFACTURING CO., LTD., Farringdon Avenue, E.C.—Leaflet G 958 announcing reduced prices and increased discounts for "Gral" lamps, especially the 50 and 100-C.P. sizes.

MESSRS. FALK, STADELMANN & CO., LTD., 83/87, Farringdon Road, E.C.—Revised list P. 560 illustrating and describing the "Efesca" auto-transformers and giving reduced prices for same. Though this is the quiet time of the season a steadily increasing sale for these transformers is being experienced. Copies of the list will be sent to trade readers on application.

"A Fleet in Being."—With the compliments of CALLENDER'S CABLE AND CONSTRUCTION CO., LTD., we have received a framed etching by C. J. Green, of "A Fleet in Being," in which there appear a number of His Majesty's ships of war that have, as part of their electrical equipment, cables made at the works of the company. The vessels are these:—*Bellerophon*, *Indomitable*, *Defence*, *Boadicea*, *Bellona*, *Superb*, *Temeraire*, *Invincible*, *Inflexible*, and *Vanguard*.

Ordnance "Jam-Coolers."—THE ELECTRIC AND ORDNANCE ACCESSORIES CO., LTD., Aston, Birmingham, inform us that they have recently received an order for two 53-in. "Ordnance" centrifugal cased fans through their Lancashire agent, Mr. J. Crawford. These fans are to be supplied to Sir William P. Hartley, the well-known jam manufacturer, for the purpose of jam cooling. Each of the fans is capable of dealing with 36,200 cb. ft. of cold air per minute against ½-in. water-gauge, and runs at the low speed of 160 R.P.M., absorbing not more than 5 B.H.P. The fans will be belt-driven by one 10-H.P. motor, which was formerly used for driving the fan which is being replaced by the above.

Condensing Plant.—MESSRS. MIRRLEES, WATSON CO., LTD., of Glasgow, received during March and April the following contracts:—

Surface condensing plant, for the Braidwater Spinning Co., Ballymena, per British Thomson-Houston Co.; also for Spencer Moulton & Co., Bradford-on-Avon, for the Baroda State, India, and for the Liverpool Corporation, three sets for 2,500-KW. Curtis turbine, per the British Thomson-Houston Co., Ltd. (repeat order).

Barometric condensing plant for the Salt Union, Ltd.; also for Central and South America, Spain, Vancouver and Kimberley.

The whole of these orders represent a steam duty exceeding 300,000 lb. per hour.

Steel Refining by Electricity.—The Swedish Co. "Elektrometall," of Ludvika, with regard to whom, as patentees and builders of electrical reducing furnaces for smelting iron ore, a notice appeared in our issue of last week, have also patented an electric furnace for the refining of steel. We are informed that there are already several in Sweden working with great success, employing two-phase current, which ensures a perfectly even quality of metal. Although energy is here too costly to make electric smelting a commercial success, the refining of steel by electricity from public supply mains is quite feasible, and reduces the cost of production as compared with that of refining by the ordinary methods. Messrs. Elektrometall have secured the services of Mr. Jens Orten-Boving, M.I.M.E., of 72 and 74, Victoria Street, Westminster, to act as their agent for Great Britain and all countries, except India and Canada.

The Cable-Makers' Association.—Mr. A. H. Howard, secretary of the Cable-Makers' Association, informs us that Messrs. Charles MacIntosh & Co., Ltd. (William Rickard, Ltd.), have ceased to be members of the Association.

Coal-Handling Plant.—MESSRS. R. H. LONGBOTHAM AND CO., LTD., of Wakefield, have received an order for a complete coal-screening plant for the Cortonwood Colliery Co., Ltd. near Barnsley. This plant, which will be thoroughly up-to-date, is to be used in connection with a complete new washing and coke-oven installation, and will have a capacity of 1,200 tons per day. The firm erected an elevating plant in connection with the Manchester Infirmary, which was recently opened by the Prince of Wales. At the present moment they are also engaged in erecting a very large coal-handling plant for a South Yorkshire colliery, in addition to a screening plant for use in the north of England. Messrs. Longbotham have recently designed a compact hauling engine.

Big Order for Chilled Wheels.—During the past six years, the BRITISH GRIFFIN CHILLED IRON AND STEEL CO., LTD., of 139, Cannon Street, London, E.C., and Barrow-in-Furness, have supplied for the Central Northern Railway—one of the Argentine Government lines—upwards of 10,000 28-in. diameter double-plate chilled wheels. We understand that the results obtained from such wheels have been most satisfactory, and the company have not had to replace a single wheel, nor have they received a complaint; it is, therefore, not surprising that the Government have specified Griffin wheels. The British Griffin Co. have now received an order for 10,480 similar wheels; this is believed to be the largest order for chilled wheels ever placed in Europe.

LIGHTING and POWER NOTES.

Bexhill.—The financial statement on the electric light undertaking for the year ending March last shows that after deducting £3,884 in respect of repayment of loans, and £220 for depreciation, the year's working resulted in a net profit of £536. Last year's net profit was £886.

Bolton.—A meeting of the Electricity Committee was held last Friday, when the balance-sheet was under consideration. It was resolved that £6,500, part of the net profits, be allocated to the relief of the rates. The estimated amount of profit for the ensuing year is £6,000. In the previous year the Committee gave £7,500, and estimated to give £6,000 this year.

Burton.—The result of the past year's working of the Corporation electricity department was a surplus of £836, as compared with £1,104 in the previous year. In common with others, the undertaking is suffering temporarily from the more efficient lamp, but the sale of motor and heating units is on the increase, and among the applications for motive power in hand is one from Messrs. Mountain & Gibson for about 400 H.P.

Bury.—For the year ending March last, the electricity department sold 3,217,360 units, an increase of 7·1 per cent. on the previous year. It is anticipated that the net profit will be £2,850, a considerable reduction on the previous year's figure, £4,026. The decrease is attributed to reductions in price, economical lamps, and depression in the cotton trade.

The Electricity Committee recommends that two 500-KW. motor-generators be obtained from the G.E. Co. for use in connection with the new H.T. supply.

Camberley.—At the last meeting of the U.D.C., it was stated that the Electric Light Committee had interviewed Messrs. Medhurst and Bremer (whose report was in the hands of the Council), also the C.R.E., Aldershot and the War Office, with reference to supplying electrical energy to the War Office property, and that they were favourably received at the interviews. The Yorktown and Blackwater Gas (Electric Lighting, &c.) and the Aldershot Gas and Water Bills had passed the committee stage in the House of Commons, the first-named company securing the Staff College area for its district. Both companies had obtained electric powers over their own gas areas, but in each case a suspensory clause had been inserted, by which these powers were suspended for a year, to enable the Council, if it desired, to take the matter up. The result of the Committee's investigations would be reported at the next meeting when a recommendation would be made on the question of the desirability of the Council applying for an order to the B. of T.

Canada.—The City of Toronto has issued a schedule of rates for power users when the hydro-electric line from Niagara Falls is completed. This does not include the additional charge on the peak to users of power who have the meter rate, this additional rate being 6 cents per H.P. The rates vary from $2·29 to $1·72 per H.P. per month for maximum demands of 300 to 2,000 H.P. respectively.

The Byllesby Co., of Brandon, is offering to develop 150,000 H.P. at Great Falls. Construction work will start when 20,000 H.P. is contracted for. Supplies of 100 H.P. will be delivered at $20 per H.P. per annum, while for amounts of over 5,000 H.P. the charge will be $15.

Canterbury.—The Lighting Committee has just given notice that in future the charge for supply to motor-generators for the purpose of generating electricity for lighting purposes will be at the rate of 4d. per unit. Apparently the power rate of 1½d. has applied previously.

Carlisle.—The Electricity Committee has adopted a recommendation by the engineer to expend £1,650 on feeders to new districts; also to apply for a loan of £5,750 for various plant extensions in connection with the undertaking.

Continental Notes.—ROUMANIA.—It is announced that the municipal authorities of Bucharest have decided on the establishment of a central electric lighting station in the town at an estimated cost of £80,000.

GERMANY.—The Rhenish Gesellschaft für Braunkohlem Berghau proposes to establish a central electricity generating station in connection with its collieries at Bergheim, for the supply of energy for electric lighting and power purposes in the Bergheim and Euskirch districts.

Cookstown (Ireland).—A special meeting of the U.D.C. has been held to consider reports regarding electric lighting schemes from Messrs. Wilkins & Burden and from Messrs. Miller, Wilson & Pegg.

Crewe.—At a meeting of the T.C. on Wednesday last week, it was announced that the surplus on the year's working of the electricity department was £981, which, with the surplus in April last year brought forward (£1,345), made a total surplus on revenue account of £2,327. It was resolved to transfer £500 to the general district rate, £605 to the reserve fund, and carry forward £1,222.

Darwen.—The profits on the electricity undertaking for the past year were £627, as compared with just over £100 the year before; the increased profit is due to greater economy at the works.

Durham.—At Messrs. Pease & Partners' collieries at Crook, an installation of 90 patent coke ovens has been in operation for some time, and quite recently a decision has been arrived at to increase this equipment by the immediate laying down of an additional 30 ovens—all of the "Otto-Hilgenstock" type. There is provided a by-product recovery plant capable of dealing, not only with the gases of these 120 ovens, but also with those of two old batteries. The complete installation of "Otto-Hilgenstock" ovens will have a total coking capacity of considerably over 5,000 tons per week. Coal will be delivered into bunkers by an aerial ropeway, from whence it will be conveyed automatically into the coal compressing boxes, each box being capable of charging 60 ovens. The coke will be mechanically quenched on an inclined platform, and loaded by means of a conveyor over a screening plant into trucks. The by-product plant, which will be supplied with serpentine air-coolers, constitutes the largest plant erected in this country in connection with coke manufacture. A modern sulphate factory is provided, and the whole installation has been designed with the object of eliminating as far as possible all manual labour, the operations, wherever possible, being by means of electric power. The waste heat from the 90 coke ovens at Crook is being utilised at a power station which has been provided in the immediate vicinity by the Bankfoot Power Co., in which Messrs. Pease & Partners have subscribed one-half of the share capital, and the Waste Heat and Gas Electric Generating Stations, of Newcastle-on-Tyne, the other half less five shares. At this station, which was put into commercial service a few weeks ago, there is plant of 3,300 H.P., supplying three-phase current at 3,000 volts and 40 cycles.

East Grinstead.—The Sussex Electricity Co. has asked the U.D.C. to support a scheme of electric lighting for the district, energy to be distributed by overhead cables. The Council has decided to obtain further particulars.

Falkirk.—The decision of the T.C. to call in the aid of the Scottish Central Power Co. to supply new customers instead of extending the Corporation plant, is still the subject of much controversy; a public debate on the matter between two members of the Council representing the majority and minority is proposed.

Hereford.—The T.C. has applied to the L.G.B. for a loan of £8,000 for electric light purposes.

An electrical exhibition, under the auspices of the Corporation, was opened on Monday last in the Shire Hall.

Kildary.—Probably one of the smallest companies to be formed under the limited liability laws is the Strathpeffer and Dingwall Electric Co., Ltd., at Kildary, in Ross-shire. The capital is only £100. The company is to supply electricity for lighting and other purposes to Strathpeffer and Dingwall; and as Lady Cromartie, one of the subscribers, is the owner of the land all round there, including Strathpeffer, the monopoly will not be difficult to retain.

Llandudno.—A L.G.B. inquiry was held recently into the application of the Council for authority to borrow the sum of £2,450, for extensions in connection with their electric lighting plant, including a boiler, engine, dynamo, switch panel, &c., the whole of the new plant being required to supply additional energy to the Llandudno and Colwyn Bay Light Railway. There was no opposition.

London.—At a recent conference of Borough Councils owning electricity undertakings, and held at Shoreditch, the Associated Municipal Electrical Engineers of Greater London were asked to draw up a scheme for linking up. The Associated Engineers have done this, and their report shows that they have made careful inquiries as to the capacity and type of plant at present in use at the electrical stations of the several B.C.'s, and more especially of what is known as "spare or reserve plant." They have also collected a large amount of statistical data, and are in a position to submit an estimate of the cost of carrying out a scheme of linking up, but they desire that details shall not be published at present. The various B.C.'s owning electricity undertakings are adjourning the consideration of the report of the Associated Engineers until a joint conference of representatives of the metropolitan electrical companies and Councils has been held. Arrangements for this joint conference are now being made.

WESTMINSTER.—The City Council reports that the Borough Councils of Battersea, Camberwell, Chelsea, Fulham, Kensington, Shoreditch, Southwark, Wandsworth and Woolwich have approved of the action taken by Westminster in protesting against the policy of the L.C.C. in encroaching on the jurisdiction of the metropolitan Borough Councils in electric supply and other private Bills. As as result of a communication to the L.C.C., it appears that that authority has no intention of discontinuing the policy complained of, and the Westminster Law and Parliamentary Committee is considering the advisability of securing some amendment of Parliamentary procedure, which would prevent provisions affecting the rights, powers and privileges of B.C.'s from being inserted in private Bills without notice not only to the B.C. immediately affected, but to all the B.C.'s.

Longton.—On the advice of its engineer, the T.C. has decided to obtain a 300-KW. generating set, and to add to the switchboard, the cost being estimated at £2,580, which expenditure the L.G.B. is to be asked to sanction.

Market Harborough.—The U.D.C. has decided to take steps to ascertain the probable demand for electricity supply in the town.

Merthyr Tydfil.—The B. of G. has decided to accept the terms of the Electric Traction and Lighting Co. for the installation of the E.L. at the workhouse and infirmary at £521. For a minimum supply of 15,000 units per year the cost of supply will be £200 per annum, and 2½d. per unit will be charged for any excess.

Middlesbrough.—At a meeting on the 5th inst., Mr. H. M. Taylor, the electrical engineer, submitted his annual report. This showed gross profits for the year amounting to £7,597, or 6·9 per cent. on capital expenditure, as compared with £6,058, or 5·8 per cent. for the previous year. The net profits were stated to be £852, as compared with a deficit last year. The shipyard strike has adversely affected the receipts, and there has also been considerable depression in local trade.

Rochdale.—The gross revenue of the electricity department for the past year was £20,329, being £49 less than in the previous year. The net profit was £4,830, which was £701 more than 12 months ago. Receipts for current showed a reduction of £25. Capital expenditure amounted to £7,602, making a total to date of £95,849. The reserve fund, with £830 proposed to be added from the profits, will amount to £6,258.

Rotherham.—The annual report of Mr. Edward Cross, the electrical engineer, shows that on March 30th there were on the books 426 consumers, the equivalent of 40,039 8-C.P. lamps, the figures 12 months before being 382 and 32,602 respectively. During the year 1,739,136 units were sold, showing an increase on the previous 12 months of 39,031. The total was made up as follows:—Power and heating 204,491, increase 28,993; traction 1,238,149, decrease 31,198; lighting 296,496, increase 41,236. The works costs averaged ·628d. per unit, an increase of ·050d. on the previous year. At the end of last year the department

had accumulated a renewal fund of £9,161, which, in his opinion, was sufficient to meet any emergency. This year the department has a further balance of £3,098, which, if added to the previously accumulated balance, makes a total of £12,260. Mr. Cross attributed a portion of the increase in the working costs to a considerable number of small capital charges which had been paid out of revenue. The Committee has decided to grant £2,000 towards the rates.

Seulcoates.—The B. of G. has decided to install its own electrical plant at the workhouse. The Hull T.C. offered to supply energy on a restricted-hour system from 11 p.m. to sunset at 1d. per unit, or a continuous all-day and all-night supply during the summer at 2d. per unit, and a restricted supply during the rest of the year at 1d. per unit.

Sheffield.—The T.C. has applied to the L.G.B. for a loan of £50,000 for mains, feeders, general extensions and sub-stations, and £6,000 for services.

Stockton-on-Tees.—The Cleveland and Durham County Electric Power Co. has applied to the B. of T. for permission to use an overhead transmission line to the works of the British Chilled Roll and Engineering Co., Haverton Hill.

Swansea.—The working of the electricity department during the year ending March last resulted in receipts amounting to £22,000, and expenditure, £11,000. After meeting financial charges, a surplus of £1,794 remained, as compared with £789 in the previous year.

Trafford Park.—At the end of last year the Trafford Power and Light Supply (1902) Ltd., agreed to supply electrical energy on the three-phase A.C. system to the new works now being erected by the British Steel and Wire Co. at Trafford Park, which are about a mile distant from the power station. This step has necessitated the installation of two rotary converter sets, each of 350-KW. capacity arranged to take direct current and supply three-phase A.C. at 360 volts, which is transformed by two 350-KW. static transformers to 6,600 volts for transmission to the sub-station on the company's premises. The supply is again transformed down to 420 volts for the supply to motors, &c. The converting machinery and switchgear are being supplied by the Westinghouse Co., and the cables by Messrs. Glover. At the end of 1908 other extensions were made consisting of a Belliss engine coupled to a 1,000-KW. Siemens D.C. generator, with surface condensing plant, &c., and the building was enlarged. In 1905 a Howden triple-expansion engine coupled to a 1,000-KW. Westinghouse D.C. generator was installed, while previously additions were made in 1903 and 1902. The whole of the extensions have been carried out to the designs of Messrs. Lacey, Sillar & Leigh, the company's consulting engineers.

Walton-on-the-Naze.—The B. of T. has granted a prov. order for electric lighting to the Coast Development Corporation, Ltd.

Watford.—A L.G.B. inquiry was held on May 6th into the application of the U.D.C. for a loan of £4,952 for E.L. purposes. There was no opposition.

West Ham.—The electrical engineer has been for some months in communication with the tramways manager as to improving the traction supply in the Stratford district, and has agreed to lay a ·15 6,000-volt two-phase twin concentric cable from the generating station to the Town Hall, installing rotary converters and transformers and the necessary switchgear, at a total estimated cort of £6,258. The value of the tramways cable recovered will be about £9,000. The electricity department undertakes to take over from the tramways department £6,000 worth of this cable into stock, and the remainder is to be purchased as required until the whole is used. Under the foregoing arrangements the tramways department cuts out the transmission losses between Canning Town and Stratford, valued at approximately £1,000 per annum at no cost to itself; and the electricity department hopes to improve the conditions of supply.

In conjunction with the above scheme, the ordinary supply arrangements from Canning Town to Stratford, will be rearranged by laying a 6,000-volt cable to the Town Hall (duplicate of the proposed tramway cable), and by linking up the 6,000-volt supply at High Street, with the proposed new cable. The cost of this will be £1,000, which is the net cost of the three schemes on capital account.

As several important matters relating to electricity are pending, the Electricity Committee has decided, subject to the consent of the Marylebone Council being obtained, that the services of Mr. Seabrook be retained as consulting electrical engineer at a fee of 100 guineas for a period of one year, or such time as may be necessary to finally dispose of the several pending matters. Steps are being taken to fill the vacancy caused by Mr. Seabrook's appointment to Marylebone.

West Hartlepool.—At a meeting of the T.C. on the 4th inst. the electric lighting accounts for the year ended March 31st were submitted. The Lighting Committee recommended that the surplus of £714 be transferred to the reserve fund. The gross income increased from £14,795 in 1907-8 to £15,307 this year, an increase of £512. The working expenditure increased from £8,778 to £8,832, an increase of £64. A balance of £6,474, equal to 5¾ per cent. on the gross income, was carried to the net revenue account; £2,719 was paid for interest, and £3,186 in loans.

TRAMWAY and RAILWAY NOTES.

Barrow-in-Furness.—The Council has decided to approach the B.E.T. Co., as to that company proceeding with the equipment of the proposed tramway over Walney Bridge.

Belfast.—It is understood that it is the intention of the directors of the Cavehill and Whitewell Tramway Co. to promote a Parliamentary Bill at an early date for running powers over the Belfast Corporation Tramway system. A Bill was promoted in Parliament three or four years ago on similar lines, but was withdrawn on the understanding that the Corporation would apply for powers to purchase the concern. The Corporation carried out its part of the agreement, but Parliament refused to sanction the proposal, and subsequently the City Council refused to consider the question of a working agreement.

Blackburn.—The annual report of Mr. J. H. Cowell, tramway manager, issued on May 6th, reveals a deficiency of £4,804 on the year's working, due largely to extraordinary expenditure (£13,323) on general repairs and maintenance of permanent way and rolling stock. The working expenses were £43,503, and the income £60,131; the balance of £16,629 was absorbed by the payment of £21,493 in repayments of loan instalments and sinking fund, interest on capital, &c., leaving a net deficit of £4,804. There was a decrease of £44 in traffic receipts, and the passengers totalled 10,737,528 compared with 10,877,155 for the previous year.

Bournemouth.—The Corporation tramways are, we understand, estimated to show a deficit of £6,000 on the past year's working.

Burnley.—Twelve months ago it was estimated that the tramways would yield a profit of £8,179, but the actual profit has been £8,381. The manager (Mr. Mozley) states in his annual report, issued on May 5th, that for the first time there is placed towards the relief of the rates a sum of £2,381. The amount added to the reserve fund is £6,000, making a total of £8,380. There is now put aside for reserve, renewals and depreciation, £38,800. Moreover, this money is nearly all invested outside the Corporation, and is bringing in substantial dividends. The passengers carried numbered 12,176,782, compared with 12,355,958 last year, whilst the car-miles run were 1,229,224, compared with 1,202,333 the previous year. The gross income was £62,669, against £64,321. Other interesting figures are: Traffic revenue, £62,609; total revenue, £62,669; working expenses, £40,950; interest on capital, £5,537; and sinking fund, £5,088.

Burton-on-Trent.—The returns of the past year's working of the Corporation tramways shows a deficit of £1,747 as compared with £121 in the previous year. During the past two years traffic receipts have shown a decline of some £1,400, attributable to local trade depression; during 1908-9 the average traffic revenue was 7·73d. per car-mile, and the operating cost, 6·37d. per car-mile; over three million passengers were carried. Notwithstanding the bad year, the Committee has decided to set aside £1,000 to reserve, thus making a debit balance of £2,747 for the year.

The T.C. has decided to lease to the Midland Railway Co. for 21 years, at an annual rental of £825, two lines of tramways; the company will take energy from the T.C. at 1·3d. per unit.

Canada.—Legislation has been introduced into the New Brunswick Parliament providing that all railways running through the timber reserves must be equipped solely with electric locomotives.—*Electrical World*, N.Y.

The Ottawa Electric Railway has applied to the City Council for permission to open up three loop lines in parts of the city where these are required. The company is introducing the "Pay-as-you-enter" cars on all lines on which there are loops.

Cardiff.—At the Council meeting on Monday last, a recommendation of the Committee was passed after much discussion, to raise the fares generally, and give the tramways manager greater freedom in handling the undertaking.

Continental Notes.—AUSTRIA.—Plans are being prepared in respect of a projected electric railway between Trieste and Falkenberg, a distance of about 12½ miles.

Fife.—Inverkeithing and Burntisland T.C.'s comment favourably on the proposal for a new tramway from Kirkcaldy to the Naval Base at Rosyth. The plan shows a route through Kinghorn, Burntisland, Aberdour and Inverkeithing, to the end of the new Admiralty Road at Rosyth. The promoters desire a concession for 42 years, the undertaking to be purchasable by the Councils as a going concern, conditional upon the other road authorities purchasing at the same time. They also desire the Councils to assign their rights to the company for supplying electric light and power, the former at 6d. per unit and the latter at 3d. The scheme is strongly backed, and none of the Town Councils are likely to oppose it, as they recognise it would mean a great boon to the people.

Glasgow.—The T.C. Committee has recommended that a payment of £25,000 be made from the tramways department to the Common Good, for the half-year, ending Whitsunday.

London.—STEPNEY.—The B.C. has again had under consideration the proposals of the L.C.C. in regard to the Aldgate-Bow tramways. At its meeting on the 5th inst. it was agreed to

inform the L.C.C. that the B.C. could not see its way to consent to the use of the overhead system on the section of route mentioned.

Luton.—The T.C. has assented to the lease of the tramways being transferred by Messrs. J. G. White & Co., Ltd., to Messrs. Balfour, Beatty & Co., Ltd.

Milnrow.—An agreement on all essential points has been arrived at between the representatives of the Rochdale Corporation and the U.D.C. for an extension of the Rochdale tramways to the district, and the next step will be the securing of a prov. order by the U.D.C. authorising the construction of the line. All the actual work of construction is to be done, it is understood, by the Rochdale Corporation by agreement in this case, as in the case of the Whitworth extension. The prov. order probably cannot be obtained this year.

New Brunswick.—The Legislature is taking steps to compel, if possible, the Grand Trunk Pacific to run all trains through New Brunswick by means of electricity, and thus prevent forest fires. The G.T.P. passes through a densely timbered country.

Reading.—The gross profit on the working of the tramways for the year just ended amounted to £14,763, and after meeting the usual financial charges, a surplus of £3,390 remained, together with accrued interest amounting to £253.

Rotherham.—The tramways manager reports a decrease in receipts of £170 on the year's working. During the current year there will be an expenditure on capital account of between £24,000 and £25,000. There will also be something like £11,000 spent on renewals account, on the Tinsley track. The Committee has decided, in the event of its being necessary to keep the rates at 9s. in the £, to devote the sum of £1,000 from the tramways undertaking to this purpose.

South Shields.—The Tyne tube scheme was discussed at a meeting of the T.C. on the 6th inst., when Ald. Lawson submitted a resolution to the effect that that Corporation should join with Tynemouth Corporation in guaranteeing the interest upon one-half of £100,000 debentures according to rateable value on condition that the N.E. Railway Co. guaranteed the interest on the other half. After a long discussion, in which the pros and cons of the financial side figured largely, the resolution was lost by 20 votes to 11.

The dispute between the tramways and electricity departments concerning the energy used by the tramways is still unsettled; sub-Committees of the two departments are now trying to come to an agreement on the matter, which involves over £1,000.

Southend.—The T.C. has decided to apply to the Light Railway Commissioners for the revival of the powers of the Southend-on-Sea and District Light Railways (Extensions) Order, 1904.

Tynemouth.—At a meeting of the Council on the 7th inst., the following resolution was adopted:—"That this Council declines to negotiate further with the promoters of the North and South Shields Electric Railway Co. on any question having for its object financial guarantee out of public funds."

Wolverhampton.—A contract has been entered into by the Tramways Committee with Mr. Trentham, of Handsworth, for the construction and electrical equipment of the new tramways from Queen Square to Lea Road. The work is to be commenced on June 7th, and it is hoped that it will be completed by the end of August.

TELEGRAPH and TELEPHONE NOTES.

Australia.—The *Standard* Australian correspondent states that the Federal Government's cable between Tasmania and the mainland of the Commonwealth has been opened, and the privately-owned lines, which have been the means of communication in the past, have been forced to cease operations. Apparently reference is made to the cables of the Eastern Extension Telegraph Co.; the matter is mentioned in our "City Notes" to-day.

Canada.—The Saskatchewan Government has finally purchased the system of the Bell Telephone Co. in that province. The price paid was $367,000 in cash, and there is yet due the province some $10,000 in unearned rentals. The system consists of 469·4 miles of long-distance lines, with 13 exchanges. The transfer was to be made on May 1st. This was the last mileage the Bell Co. owned in Canada between the Great Lakes and the Pacific coast, and Press dispatches state that the Ontario Government will shortly consider the purchase of the company's system in that province.—*Electrical World*, N.Y.

The *Electrical World*, New York, says that the Manitoba Government Telephone Commission has issued a notice to the effect that in future linemen and cablemen will work 10 hours per day instead of nine hours as previously. No advance in salary is to be given excepting to those paid by the hour. This action on the part of a Government department forms a striking departure from the customary procedure under municipal ownership.

New Atlantic Cable.—The *Standard* reports that the Argentine Government has decided on the construction of a submarine cable for the transmission of telegrams from Argentina by a direct route. A new cable is to be laid from Buenos Ayres to the island of Ascension, from there to Madeira, and from Madeira to Europe. The contract for making and laying the cable will be given to a British firm, which has secured it in the face of strong Continental competition.

It is also reported that the Western Telegraph Co. are desirous of laying a cable between the Argentine and Ascension, and are negotiating towards this end with the Brazilian and Argentine Governments.

New Cable Ship.—The *Telconia*, the new cable ship being constructed for the Telegraph Construction and Maintenance Co., has been launched. She is 205 ft. in length and 30 ft. 9 in. in beam. Two single-ended Howden's boilers will supply steam to the two sets of triple-expansion engines. She has two cable tanks, with 7,500 cb. ft. capacity. The *Telegraph Age* further states that the test rooms are equipped with the latest designs of instruments, cable machinery and gear.

Paris Telegraph Strike.—Ever since the "settlement" of the recent strike of telegraph operators in Paris, there has been unrest and agitation, accompanied by threats of a renewal of the fight; on Tuesday last these threats were translated into action. The Government had made extensive preparations to combat the movement, and declared that its attitude would be inflexible. A serious feature of the present strike was the refusal of the naval reservists at St. Nazaire to do the work of the postal servants on strike. The decision to strike was attained immediately after a debate in the Chamber of Deputies, in the course of which the Government denied that M. Clemenceau had made any promise, as had been alleged by the strikers, to remove the P.M.G., M. Simyan.

On Wednesday the Council of Ministers dismissed 228 employés, mostly postal servants. The latest news available as we go to press indicates that the strike is only partial, and is expected to prove a *fiasco*.

Telegraphic Interruptions:—

Port Arthur-Chifu	March 9, 1904
Pontianak-Saigon	Sept. 16, 1908
Obock-Djibouti	April 15, 1909
Jamaica-Colon...	May 5, 1909

Wireless Telegraphy.—As some appear to be under the impression that a wireless telegraph installation for receiving purposes only does not require a licence, the Postmaster-General has thought it desirable to call the attention of the public to the wording of Sec. 1 (1) of the Wireless Telegraphy Act, which is as follows: "A person shall not establish any wireless telegraph station, or install or work any apparatus for wireless telegraphy, in any place or on board any British ship except under and in accordance with a licence granted in that behalf by the Postmaster-General." This provision covers receiving as well as transmitting stations.

Wireless Telephony.—A factory is being built by the Radio-Telephone Co. in Newark, N.J. A steel tower is being erected by the Great Lakes Radio-Telephone Co., an associate of the former concern, on the roof of the Hippodrome, in Cleveland, Ohio, and there will be 75 stations working along the shores of the lakes. A wireless telephone system has also been opened to the public at Portland, in Maine.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—Victoria.—50 coin attachments for the P.M.G. See "Official Notices" May 7th.

Victoria.—Eight sections of common battery switchboard and subscribers' apparatus for Hawthorn Exchange. See "Official Notices" May 7th.

Melbourne.—May 25th. 1,125,000 flame, and 70,000 ordinary arc lamp carbons for the City Council. See "Official Notices" May 7th.

Melbourne.—July 14th. One direct-current steam-driven generating set of 1,000, 1,250 or 1,500 kw., for the Council. See "Official Notices" to-day.

Melbourne.—June 1st. 69,750 incandescent lamps for the Council. See "Official Notices" to-day.

Queensland.—Telephone material for the P.M.G.'s department. See "Official Notices" May 7th.

New South Wales.—One photometer, &c., for the P.M.G.'s department; also a branching multiple magneto switchboard. See two "Official Notices" to-day.

Blackburn.—May 21st. Uniform clothing for the Corporation Tramways Department. See "Official Notices" to-day.

Farnworth.—May 24th. Extra-high and low-tension cables, and 10 circuit-breakers, for the U.D.C. electricity department. Mr. R. B. Leach, electrical engineer.

France.—The municipal authorities of Provins (Seine-et-Marne) have just invited tenders for the concession for the electric lighting of the town during a period of 30 years.

Govan.—The tender of the Lancashire Dynamo and Motor Co. has been accepted for motors of 5 H.P. to 30 H.P. for the ensuing year. The company have now had the contract for six years.

Hornsey.—May 28th. Cables for the T.C. See "Official Notices" to-day.

Hungary.—May 31st. The municipal authorities of Orsova are inviting tenders for the establishment of a central electric lighting station in the town.

Kingston-upon-Hull.—May 17th. Air-space telephone cable and telephone instruments, for the Council. See "Official Notices" May 7th.

London.—St. Pancras.—July 10th. Arc lamp carbons for the B.C. See "Official Notices" April 30th.

Poplar.—May 26th. Two electric fans for the workhouse laundry, for the Guardians. See "Official Notices" to-day.

L.C.C.—May 25th. Electric lighting, &c., at schools at Putney and Peckham. See "Official Notices" to-day.

L.C.C.—June 15th. 200 double-deck roof-covered car bodies, 200 car sets of maximum-traction swing bolster trucks, and 200 complete electrical equipments for operation upon both conduit and overhead trolley systems. See "Official Notices" to-day.

Stoke Newington.—May 19th. Meters and demand indicators for the Council. See "Official Notices" to-day.

Manchester.—May 18th. Main switchboard, distribution boards, tramway rails, tie-bars, trolley wire, and rail bonds, for the Corporation. See "Official Notices" May 7th.

Mexborough.—June 8th. 100-KW. engine and generator, switchboard extensions, piping, and water purifier and softener for the U.D.C. electricity works. See "Official Notices" May 7th.

Plymouth.—The Tramways Committee invites tenders for copper wire bracket fittings, &c., and the Electricity Committee invites tenders for coal, for 12 months.

Roumania.—June 15th. The municipal authorities of Ploessi are inviting tenders for the concession for the establishment and working of a system of electric tramways in the town.

Shildon.—May 22nd. Electric light installation at Wesleyan Church. Specification to be seen on application to Rev. W. D. Pellat, 39, St. John's Road, New Shildon.

Whitehaven.—May 25th. One balancing set for the Corporation. See "Official Notices" to-day.

Wigan.—May 17th. 750-KW. engine and generator, two water-tube boilers, piping, economisers, coal-handling plant, cables, switchboard, constructional steel-work, and removal of plant from Pemberton generating station to Wigan, for the Corporation. See "Official Notices" April 30th.

CLOSED.

Belgium.—La Société de Constructions Electriques de Charleroi has recently secured a contract from the Société des Forges de la Providence for the supply of a 1,200-H.P. three-phase electric generator.

Bradford.—The Corporation Electricity Committee has accepted the tender of the Crosthwaite Fire Bar Syndicate, Ltd., Leeds, for two cooling towers at the Valley Road works, at £3,475.

Bristol.—The Docks Committee has accepted the tender of W. T. Henley's Telegraph Works Co., Ltd., for cables, &c., for the electric capstan; and that of the India-Rubber, Gutta-Percha and Telegraph Works Co. for a band for the movable electric elevator.

Burton-on-Trent.—The tender of Messrs. G. W. Green and Co. has been accepted for a further supply of trolley standard earthing devices (Pringle's patent) to complete the equipment of all the cars. This course has been decided on by the Committee in view of the recent serious case of shock to a passenger on the West Ham tramways and the heavy claim incurred.

Bury (Lancs.).—The T.C. has accepted the tender of Carr Bros., Ltd., of London, for 500 insulating bolts; that of Le Carbone, of London, for six gross of carbon brushes; and that of the General Electric Co., Ltd., for two 500-KW. motor-generator sets.

Canada.—Our correspondent writes stating that the Modern Steel Structural Co., of Waukasha, of Wisconsin, U.S.A., has, for $22,930, secured the contract to supply and erect for the Government of Canada two 60-ton 4-motor electric travelling cranes at Riviere du Loup, Quebec Intercolonial Railway.

The Canadian Westinghouse Co., Hamilton, Ont., has secured a contract for the supply and installation of a power plant for the railway at Charlottetown, P.E. Island, for the sum of $3,585.

Cheltenham.—The T.C. has accepted the tender of Heenan & Froude, Ltd., for the duplication of the refuse destructor plant, at £5,796.

Darlington.—Our correspondent informs us that the Electricity Committee had a further meeting early last week, and decided to reverse the decision come to as to submitting the tenders to Prof. Kennedy for his report. The reason for this was that the department is hard pressed for the new plant, and it was thought the delay in seeking expert opinion would result in the set not being ready for use next winter. At the full council meeting held on May 6th an alternative tender of Messrs. Belliss & Morcom, at £2,663, was accepted, the Brush Electrical Co. withdrawing their tender, as they alleged that they were unable to guarantee delivery within 22 weeks.

Fareham.—The U.D.C. at its meeting on May 4th accepted the following tenders:—

Section E.—Electric supply mains, £288.—British Insulated & Helsby Cables.
Section F.—Transformers, £172.—Spagnoletti, Ltd.
Lamp pillars, brackets and fittings, £25.—W. Lucy & Co.

France.—The French Post and Telegraph authorities in Paris have just placed contracts as follows:—M. Grammont, 200 kilometres of asbestos and rubber-covered cotton wire; and Messrs. Geoffroy & Delore, 400 kilometres ditto.

London.—Marylebone.—The B.C. has accepted tenders for annual electrical supplies as follows:—

W. T. Glover & Co.—Binding and fuse wire.
London Electric Wire Co.—Fuse wire, tinned copper sheet.
Siemens Bros. & Co.—Para strip, adhesive tape.
Wm. Patterson.—Dynamo brushes.
Le Carbone.—Carbon brushes.
British Electric Manufacturing Co.—Ceiling roses, &c.
Tucker & Co.—Switches.
Edison & Swan Co.—Switch blocks.
McGeoch & Co.—Plugs and sockets.
General Electric Co.—Switch plugs, distribution boards, &c.
Davis Electric Co.—Distribution boards, &c.
Sloan Electrical Co.—Arc lamp carbons.
Union Electric Co.—Arc lamp carbons.
Jennings & Co.—Meter boards and creosoted troughing.
British Electrical Trades Supply.—Pitch.
Armorduct Manufacturing Co.—Cut-outs.

L.C.C.—The following tenders were received for roadwork and platelaying (exclusive of rails and special trackwork) in connection with the conduit tramways from the "Plough," Clapham, to Cedars Road, near Lavender Hill, and in Malpas Road and Shardeloes Road:—

	Tramway works.	Paving works.	Total.
Dick, Kerr & Co.	£27,991	£717	£28,708
A. M. Coles	28,703	658	29,361
W. Manders	28,922	697	29,619
J. Mowlem & Co.	29,578	696	30,274
Fry Bros.	30,496	710	31,206
R. C. Brebner	32,698	970	33,669
H. M. Nowell	42,855	762	43,617
Engineer's estimate	29,020	691	29,711

The tender of Dick, Kerr & Co. is recommended, and they are to be allowed to sub-let the yokes to the Anderston Foundry Co., insulators to Doulton & Co., and tie-bars, bolts, &c., to Bayliss, Jones & Bayliss, or Guest, Keen & Nettlefolds.

The following tenders were submitted for about 4,000 tons of track rails and fastenings, and about 3,000 tons of slot rails and conductor tees:—

Track Rails and Fastenings.

Stahlwerks-Verband, Düsseldorf (manufactured by Phœnix Steel Co., Ruhrort) (rails quoted f.o.b. at Antwerp, instead of on basis of delivery in London) (incomplete tender)	£21,057
Société Anonyme d'Ougrée Marihaye, Belgium ..	22,512
Société Anonyme des Aciéries d'Angleur, Belgium ..	22,657
Bolckow, Vaughan & Co., Middlesbrough	24,950
Lorain Steel Co., U.S.A.	26,063
P. & W. Maclellan, Ltd., Glasgow (manufactured by the North-Eastern Steel Co.)	26,485
Walter Scott, Ltd., Leeds	26,865
Barrow Hæmatite Steel Co., Barrow-in-Furness ..	27,399

Engineer's estimate, £26,001.

Slot Rails and Conductor Tees.

Frodingham Iron and Steel Co., Frodingham	£21,198
Walter Scott, Ltd., Leeds	21,784
P. & W. Maclellan, Ltd. (manufactured by the North-Eastern Steel Co.)	22,012
Barrow Hæmatite Steel Co.	33,650
Société Anonyme des Aciéries d'Angleur, Belgium (incomplete tender, for slot rails only)	14,869

Engineer's estimate, £21,012.

The Highways Committee has recommended that the lowest complete tender for slot rails and conductor rails, namely, that submitted by the Frodingham Iron and Steel Co., amounting to £21,198, should be accepted, this tender being also lower so far as slot rails are concerned than the tender submitted by the Société Anonyme des Aciéries d'Angleur. As regards the track rails and fastenings, the first three tenders are for rails of foreign manufacture. Of these, the lowest, namely, that of the Stahlwerks-Verband, does not include the fishbolts required, to the value of about £600; moreover, the terms of delivery are less favourable than those provided for in the second and third tenders, the prices quoted being for free delivery on board at Antwerp, instead of delivery to the work in London, as specified in the contract. The lowest complete tender is that of the Société Anonyme d'Ougrée Marihaye (£22,512). The lowest tender for rails of British manufacture is that of Bolckow, Vaughan & Co., amounting to £24,959, which is £2,447 higher than the second tender. "We

would point out that, in the past, in cases in which materials required for tramway construction and reconstruction works have been obtained from abroad, delay has arisen owing to difficulty in arranging for deliveries in small quantities to be made in accordance with the requirements of the work for which the materials were to be used; further, in the event of its being necessary to reject any of the work, the delay caused thereby might become a very serious consideration. We are advised, moreover, that if one of the tenders for the supply of foreign rails be accepted, additional expenditure will have to be incurred for the inspection of the materials during manufacture. In these circumstances, and having regard to the terms of the resolution of November 19th, 1907, instructing committees to give a preference, wherever possible, in the purchase of manufactured articles to goods made within the United Kingdom, we have decided to recommend the Council to accept the tender of Bolckow, Vaughan & Co."

When the matter came before the Council on Tuesday there was a good deal of discussion. An amendment moved by Sir John Benn that the lowest tender (that of a Belgian firm) be accepted was defeated by 43 votes to 22. The report was adopted.

In connection with the proposed reconstruction for the underground conduit system of the Aldgate to Bow tramways, the existing low-tension cables on the route will have to be extended. The W. T. Henley's Telegraph Works Co. have offered to do the work at a reduction of 1½ per cent. on the rates under their contract of March, 1908, and the Committee recommends the acceptance of the offer. The expenditure will be about £2,250.

For withdrawing and relaying low-tension cables in connection with the working of the Victoria Embankment tramways from the Elephant & Castle sub-station the following tenders were received:

Robert W. Blackwell & Co.	£2,945
Western Electric Co.	3,148
Johnson & Phillips, Ltd.	3,191
British Insulated & Helsby Cables, Ltd.	3,199
W. T. Henley's Telegraph Works Co.	3,245
W. T. Glover & Co.	3,325
Callender's Cable & Construction Co.	3,436
Siemens Bros. & Co.	3,438

Estimate of chief officer of tramways, £3,000.

The London Electric Firm is to provide 64 sets of its patent arc lamp suspension gear in connection with the electric lighting of the Victoria Embankment, at £157.

BATTERSEA.—The Lighting Committee recommends the acceptance of the tender of Messrs. Mackenzie & Moncur, Ltd., for six arc lamp columns of drawn steel, at £12 15s. each.

STEPNEY.—The Finance and Parliamentary Committee has again recommended the tender of Mr. Daniel T. Jackson for condenser pipe work, &c., for Blyth's Wharf extension scheme, at £6,900. As a result of further inquiries addressed to Messrs. F. Handman & Co., who quoted £5,500, that firm has withdrawn its tender.

METROPOLITAN ASYLUMS BOARD.—The Board has received the following tenders for two large ambulance tramcars and two smaller ones:—

United Electric Car Co., Ltd. (accepted)	£838
Dick, Kerr & Co., Ltd.	846
Gloucester Railway Carriage and Wagon Co., Ltd.	860
Brush Electrical Engineering Co., Ltd.	875
Hurst, Nelson & Co., Ltd.	1,000
G. C. Milnes, Voss & Co., Ltd.	1,200
Mountain & Gibson, Ltd.	1,980

The engineer-in-chief's estimate was £1,120.

HAMMERSMITH.—In order to provide room for the new turbo-alternator, generating sets Nos. 2, 3 and 4, and alternator No. 1, which can no longer be worked economically for the Council's purposes, are to be disposed of. The following offers for the purchase, dismantling and removal of same were received:—

J. Pegsley, Bristol (accepted)	£510	J. B. Garnham	£315
Cohen, Sons & Co.	490	J. E. Road	300
A. L. Underwood	335	Livingston & Son	125

For a furnace for the Stirling boiler about to be installed, the Council received the following tenders:—

Brown, Duncan & Co., Liverpool (accepted)	£105
Cadogan Ironworks Co.	175
J. Howden & Co.	195
Rosser & Russell	205

For two 200-KW. transformers, the tender of the British Electric Transformer Co., at £175 each, has been accepted; and for one or more of 100-KW. size, that of Spagnoletti, Ltd., at £89 each, has been accepted.

For the supply of cable the following tenders were received, that of the Western Electric Co. being accepted for each class:—

	1,000 yd. ·05 H.T.	3,000 yd. ·2 L.T.	1,500 yd. ·05 L.T.	1,000 yd. ·08 L.T.	2,000 yd. ·025 L.T.
Western Electric Co. (accepted)	£115	£1,013	£205	£185	£192
Henley's Telegraph Works Co.	120	1,045	210	190	198
Brit. Insulated & Helsby Cables	118	1 038	211	190	194
Lahmeyer Electric Co.	121	1,052	218	194	202
Callender's Cable & Construc. Co.	155	1,057	212	198	202

For the conversion of the lift in the Town Hall from hydraulic to electric power, the following tenders were sent in to the Council:—

Titan Lift & Electric Co. (not complying with specification)	£116
Medway's Safety Lift Co. (accepted)	167
Waygood & Co.	175
Electromotor Equipment Co., Ltd.	177
J. E. Childs & Co.	178
Archibald Smith & Stevens	180
Turner, Atherton & Co., Ltd.	190
Spagnoletti, Ltd.	245
Higginbottom & Mannock, Ltd.	275
Neville, Karge & Co., Ltd.	278
Easton Lift Co., Ltd.	290

ISLINGTON.—The B.C. has received 18 tenders for the supply of between 13,000 and 17,500 tons of small coal for the electricity undertaking. The following were accepted:—

A. Blackmore & Co.—Mansfield nutty slack, at 10s. 3d. per ton.
Myers, Rose & Co.—Wingfield Manor slack, at 9s. 11d. per ton, and Stanley slack, at 8s. 7½d. per ton.
J. H. Gilman & Co.—Shirebrook nutty slack, at 10s. 8d. per ton.

Maidenhead.—The T.C. has accepted the following tenders:—

Wm. Geipel & Co.—Carbons for Crompton lamps.
Chamberlain & Hookham.—Meters (motor type).
Western Electric Co.—Cables.

Manchester.—According to the *Manchester Daily Guardian*, the Corporation will shortly be putting down in the Dickinson Street electric generating station what is believed to be the largest electric storage battery in Great Britain. It will contain some 200 cells, each 6 ft. long and 2 ft. wide. The object of installing a battery of this large size is to assist in getting over the "peak" load—*i.e.*, the evening rush—on both the lighting and the tramways. The battery is to be supplied by the Tudor Accumulator Co.

Plymouth.—The Tramways Committee has accepted the tender of Messrs. Ellacott & Sons for brake blocks, at 6s. 9d. per cwt., and steel slipper suspension bolts at 5¾d., and that of Messrs. Davey, Sleep & Co. for brake slides at 2d. each, and suspension bolts at 1s. 7d. each.

Portsmouth.—The Corporation Tramways Committee has accepted the tender of the Acme Flooring and Paving Co., Ltd., for the supply of wood block paving.

Ravensthorpe.—The U.D.C. has accepted the tender of Ferranti, Ltd., for 50 metallic-filament lamps for street lighting.

St. Andrews.—The T.C. has accepted the offer of Messrs. William Barton & Sons, Edinburgh, to install electric light in the Town Hall.

Yarmouth.—The T.C. has accepted the tender of Messrs. G. H. Hansell & Co. for 2,000 tons of Shipley fine slack coal, delivered on rail at Yarmouth at 8s. 11d. per ton, for the electricity works.

York.—The Tramways Committee on Monday decided to recommend the City Council to accept the tender of Messrs. Dick, Kerr & Co. for the construction of permanent way and equipment, excluding cars, for six miles of route, including single and double track—a total length of ten miles of track—at £78,827. The routes in the city itself, and for a considerable distance outside, will be double track. There were about 18 tenders.

FORTHCOMING EVENTS.

Royal Institution.—Friday, May 14th. At 9 p.m. Discourse on "Solar Vortices and Magnetic Fields," by Prof. G. E. Hale.

Physical Society.—Friday, May 14th. At 8 p.m. At the Imperial College of Science, South Kensington, S.W. Papers on "A Bifilar Vibration Galvanometer," by Mr. W. Duddell; and "Effect of Temperature on the Hysteresis Loss in Iron in a Rotating Field," by Messrs. W. P. Fuller and H. Grace.

Junior Institution of Engineers.—Saturday, May 15th. Visit to the British Thomson-Houston Co.'s works.

Thursday, May 20th.—At 7.30 p.m. At the Royal United Service Institution, Whitehall, S.W. Paper on "Ductile Materials under Stress," by Mr. C. A. Smith.

Royal Society of Arts.—Tuesday, May 18th. At 4.30 p.m. Paper on "Canada as a Field for British Investment," by Mr. J. O. Smith.

THE ELECTRICAL ENGINEERS
(LONDON DIVISION).

The following orders are issued for the week ending May 22nd, 1909:—

Commanding Officer—COL. R. E. B. CROMPTON, C.B.

Monday, May 17th.—"A" Company. Infantry drill, 6.45 p.m. Practice for Officers' Drill Cup competition.

Tuesday, May 18th.—"B" Company. Infantry drill, 6.45 p.m. Practice for Officers' Drill Cup competition.

Thursday, May 20th.—"C" Company. Infantry drill, 6.45 p.m. Practice for Officers' Drill Cup competition.

Friday, May 21st.—"D" Company. Infantry drill, 6.45 p.m. Practice for Officers' Drill Cup competition.

(Signed) J. H. S. PHILLIPS,
Capt. and Acting Adjutant.

4, 1909.

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THE "Z" ELECTRIC LAMP WORKS, SOUTHFIELDS.

We were recently enabled, by the courtesy of the "Z" Electric Lamp Manufacturing Co., Ltd., to inspect the works at Southfields, where the "Z" lamp is made, and we give herewith some views of the interior of the factory, showing the work in progress.

The makers claim that this was the first metallic-filament lamp to be made on a commercial scale wholly in this country. The manufacture was commenced nearly two years ago in works at Willesden, which are now devoted entirely to the making of the filaments; the bulk of the work is now carried on in the factory originally built and equipped by the Berrenberg Lamp Co., which was acquired for the purpose by the "Z" Company in May last year. The interior of the building was completely re-organised, and new plant was introduced; additional land was also secured to provide for future extensions, the total area available being about two acres. The accompanying plan shows the general arrangement of the factory and the uncovered site, which has a frontage on Standen Road, with access at the back to Pirbright Road.

The building is divided into two main portions, of which the front portion is a two-story building containing on the ground floor the engine-room, offices, and fitters' shop; the first floor is devoted to the lamp-exhausting process. The second portion is the lamp factory proper, and consists of a single floor over 200 ft. long and 50 ft. in width. The organisation is such that, starting from the store-room at the lower end, the various processes follow one another in due order down one side of the building until the completed lamp arrives in the exhausting room, after which it returns along the other side to the lamp stores in the centre.

The engine-room is equipped with a Hornsby water-tube boiler, supplying steam to a 100-H.P. Ball & Wood compound engine, which is provided with a condenser. The engine drives a 45-KW. single-phase alternator and exciter, as well as the countershaft formerly used to drive the works. The latter is now used only for the main mechanical pumps and tools; all the auxiliary machinery in the shops is electrically driven, and very shortly this system will be extended to the whole of the plant, thus avoiding the use of the main countershafting. In addition to the main engine, there is a 15-H.P. gas engine, and a 7½-H.P. motor-generator.

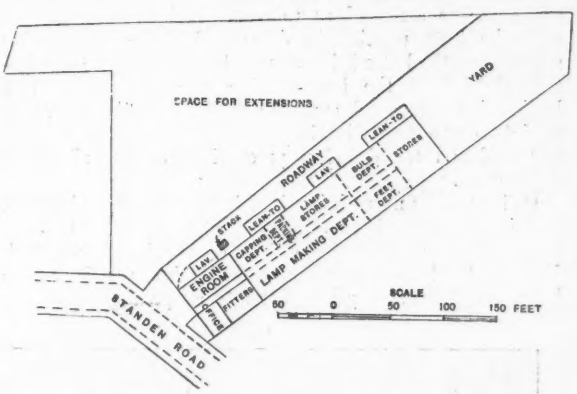

FIG. 1.—PLAN OF "Z" LAMP WORKS AND SITE.

The fitters' shop is well equipped with lathes, drilling and grinding machines, punching machines, &c, and also contains the main air-compressor and vacuum pump, to which we shall refer later.

Entering the main shop at the lower end, we come first to the stores, where all raw material is received and issued to the works as required. Next to these are the foot-making and bulb departments, where all the common parts of the lamp are made up. In the bulb department the lamp-bulbs are washed, dried, provided with stems, and opened, after which they are delivered to the sealing-in tables. In the foot-making department, the leading-in wires are made, the central rods made and provided with nickel supporting wires,

FIG. 2.—GENERAL VIEW OF MAIN SHOPS; SEALING-IN TABLE IN FOREGROUND.

and the foot glass is cut, flanged, and made up into finished feet. A novel machine is used in this department for cutting the flanged glass, as well as some very neat flange-making machines, which were specially designed by Mr. H. Hoge, the manager of the company's works at Willesden. The feet when completed pass into the "finished-part" store; at this stage they consist of the foot with the leading-in wires, and the central rod with the nickel-wire supports attached; carbon hooks are used to support the filaments at the lower ends, and these, as well as the filaments, have still to be mounted, and the filaments welded to the leading-in wires and upper nickel supports.

These operations involve a large number of processes, which are carried out in the lamp-making department; the tables are so arranged as to secure their due performance with the least possible handling and the most effective supervision, the latter being a special feature of the organisation throughout the lamp-making processes. The feet having been mounted complete with their filaments, pass straight on to the sealing-in table, after which the lamp is inspected and tested before proceeding to the exhausting department.

Owing to the fine work involved in mounting the filaments, and indeed throughout the manufacture of metal-filament lamps, a very concentrated degree of lighting is required. Each worker has her own ideas as to the best position of the lamp, and the company has therefore adopted a very simple and effective system of lighting which lends itself readily to adjustment to suit individual taste. Throughout the lamp-making department a number of ingenious little devices are in use for carrying filaments, feet, &c., which have been evolved by the staff to simplify and accelerate the work.

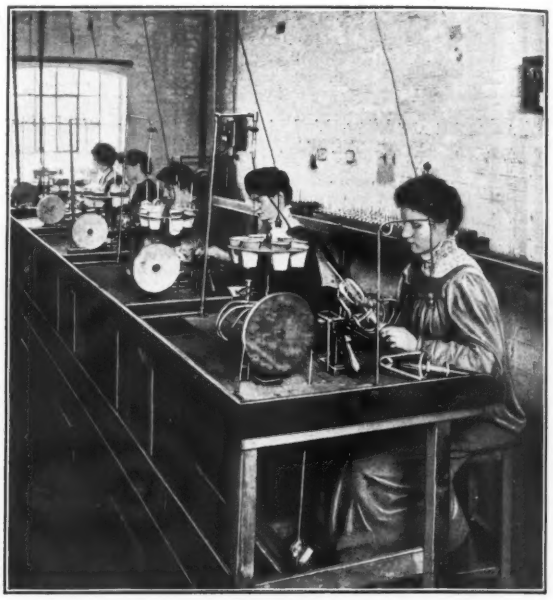

Fig. 5.—Sealing-in Table.

Fig. 3.—Foot-making Department.

The exhausting department is always the most attractive and interesting part of an incandescent lamp factory, and in this case special interest attaches to the plant, owing to the unusual features of the exhausting apparatus, which consists of both mechanical and mercury pumps. The large Berrenberg pump installed by the original owners of the factory is still in use, and we believe that this is the only instance in which a mechanical pump is employed for exhausting metallic-filament lamps. This pump is capable of exhausting a large number of lamps simultaneously; the operation entails some difficulties, but these have been successfully overcome, and several improvements have been introduced into the apparatus, which enable the company to secure the very high vacuum that is indispensable to the manufacture of metallic-filament lamps. The vacuum now obtained is as high as can be got with mercury pumps of the ordinary types, and this result has been accomplished without sacrificing the high speed of working afforded by the great capacity of the Berrenberg pump.

The mercury pumps are of the Gaede rotary type, and are electrically-driven; two batteries of these are installed, and a third battery is in course of erection.

The lamps are raised to a high temperature by external heating while they are being exhausted, and at the same time they are considerably over-run, to drive out the gases occluded in the filaments; a special chemical composition is painted on the stem of the lamp, the purpose of which is to prevent the blackening often observed during this stage of the manufacture, as well as during the subsequent life of the lamp.

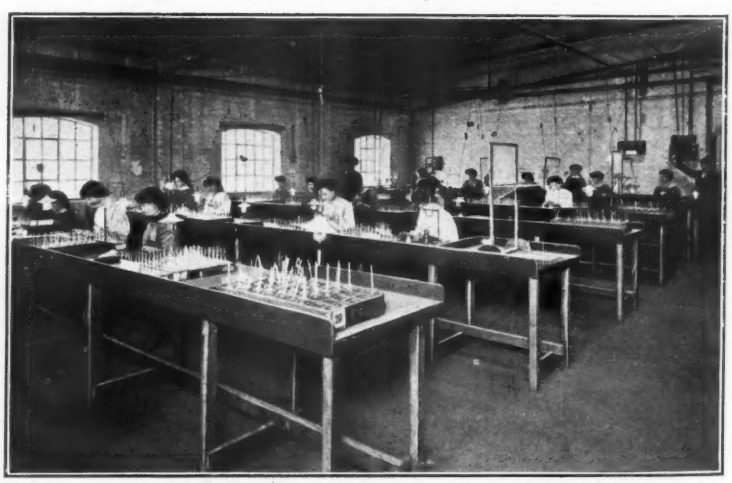

Fig. 4.—Part of Lamp-making Department.

After pumping and sealing-off, the lamps are tested on a screen for a period of one to two hours, during the latter portion of which they are considerably over-run. The vacuum is tested by the spark method, both during and after

exhaustion, and the greatest care is taken to ensure that the highest possible vacuum is obtained—much higher than in the case of carbon-filament lamps.

After "screening," the lamps are returned to the main shop, for capping and testing. All the lamps are capped with waterproof cement, with the aid of special capping machines.

The manufacture of metallic-filament lamps entails an immense amount of detail and a large number of operations, which afford numerous opportunities for breakage and bad workmanship; the secret of success, therefore, lies in excellence of organisation and supervision, and in the "Z" lamp factory these qualities have been developed to an extremely high degree. The number of breakages has been brought down to a remarkably low figure, a result partly due to the strength of the filament, and partly to the perfection of the system of control and inspection, which has been worked out to such a pitch that, when the lamps are finally tested, any defect that may be discovered in any part of the lamp can be immediately traced back to the worker at fault.

The upper curve in fig. 7 is a typical life curve of the "Z" lamp, and shows a mean drop of 1 per cent. in the C.P. for each 100 hours of burning, with a corresponding increase in the consumption. The curve shows the test carried out to 1,600 hours, but life tests far exceeding this have been made, and in many instances a life of 2,800 hours and over has been recorded, both on the test rack and in actual practice.

The "Z" lamp, like other tungsten lamps, is of the multiple-filament type, the filaments being of the hairpin shape, grouped round a central glass support and connected in series. At the pip end the filaments are supported by carbon hooks attached to the centre stem by thin steel wires; the combination of steel wire and carbon hook forms a spring support which compensates for the expansion and contraction of the filament, and at the same time damps vibration.

The centre stem is a glass rod, to which are attached the steel wires mentioned above and the supporting wires for the other end of the filament. The centre stem is attached to the foot of the lamp, which contains the leading-in wires to which the filaments are welded. The special salt which prevents blackening of the lamp is painted on the centre stem.

Our own experience of the "Z" lamps, burning two in series on 200 volts, has been very satisfactory.

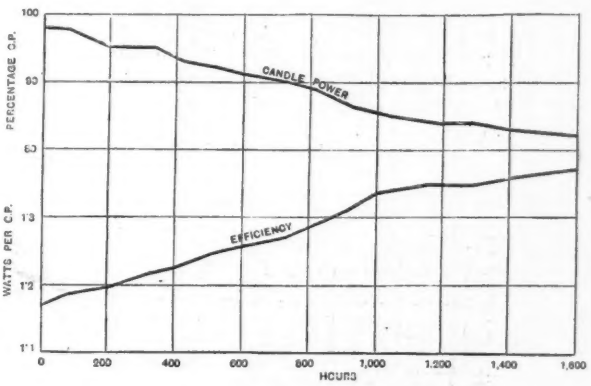

Fig. 7.—Life and Efficiency Curve of "Z" Lamp.

We are indebted to Mr. Pakenham, general manager of the company, for his kind assistance in the preparation of this article, and for the photographs with which it is illustrated. The company has made a good beginning, on the sound basis of high quality and efficient organisation, and we have no doubt that in no long time we shall have to announce that the works are being extended to cope with the increasing demand for the "Z" electric lamp.

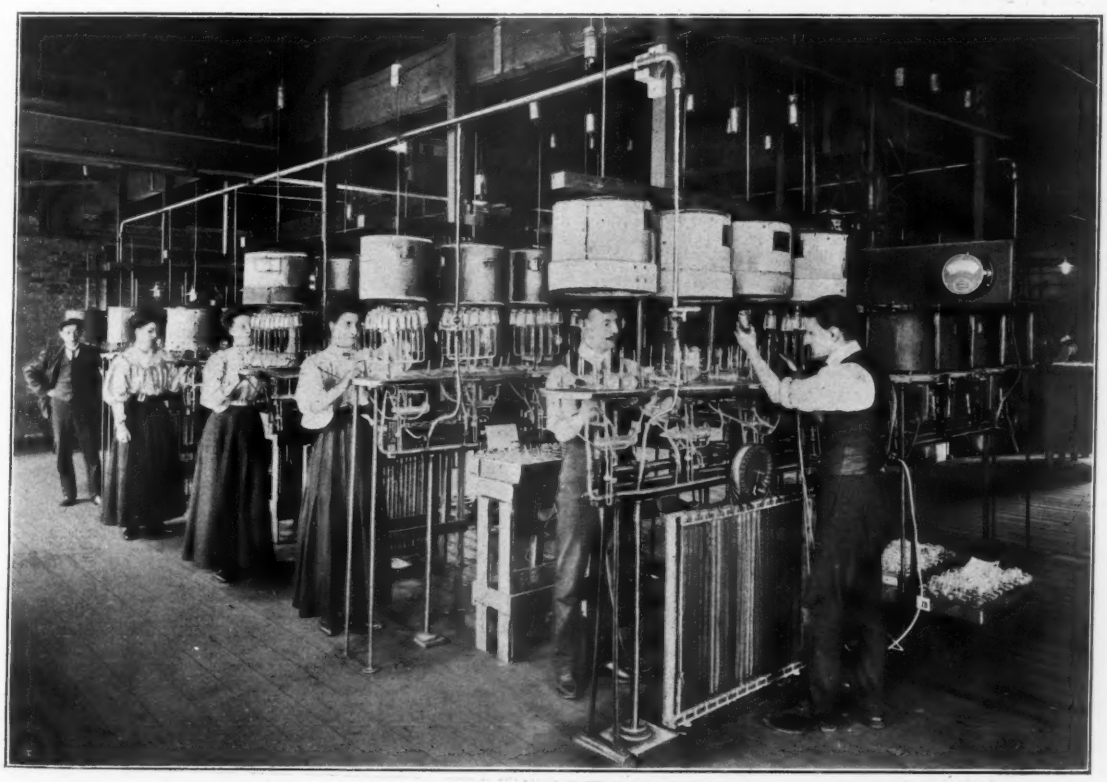

Fig. 6.—Exhausting Department.

COLLIERY ELECTRIFICATION IN THE NORTH OF ENGLAND.

Until recently, the Swalwell Pit of the Dunston and Garesfield Collieries was operated by steam plant, both for underground pumping and for the requirements on the surface. The pumps used for the main shaft were of the Evans "Cornish type," two in number. Other pumps were installed in-bye both in the five-quarter seam and the Brockwell seam, 700 yards and 480 yards from the shaft bottom respectively.

On the surface a winding drum of 8 ft. 3 in. diameter, for the Brockwell seam, and 5 ft. 8 in. diameter for the five-quarter seam, was driven by a steam engine.

The ventilating fan was 15 ft. in diameter, running at 80 R.P.M. and delivering 36,000 cb. ft. of air per minute.

In addition to this, there was an endless rope haulage, driven by a pair of engines. The rope wheel was 5 ft. in diameter, and the rope travelled at about 2 miles per hour. The main and tail haulage was operated by a pair of engines, driving through gearing drums of 4 ft. 6 in. diameter.

The whole of these engines required about 240 tons of coal per fortnight to operate them, and charging this up at a cost of 6s. 8d. per ton, this approximated to an expense of £80 each fortnight; added to this were the wages of four stokers, which totalled £12 10s. The cost of steam drive, therefore, excluding repairs, amounted to £92 10s. per fortnight.

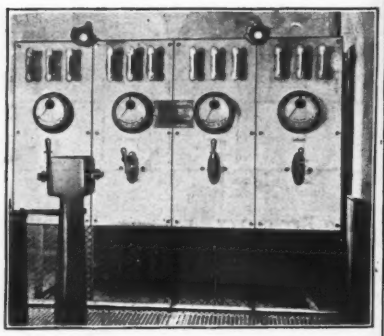

FIG. 1.—MAIN SWITCHBOARD.

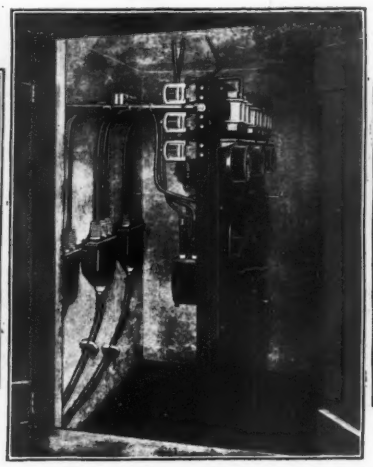

FIG. 2.—UNDERGROUND SWITCHBOARD.

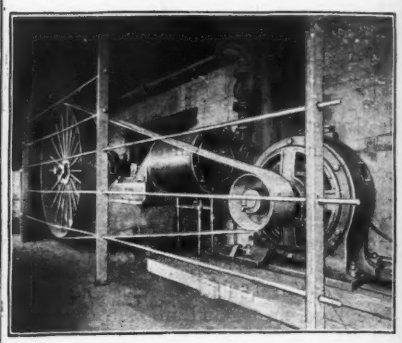

FIG. 3.—MOTOR DRIVING FAN.

The extension of operations in 1904 reached a point where the owners were induced to consider the complete electrification of the colliery, and their decision was brought to an issue favourable to electric driving by the offer of a suitable supply of electricity by the County of Durham Electrical Power Distribution Co, Ltd. Although this company now supplies many of the most important collieries in the county of Durham from its system, this is probably the first instance of a complete colliery having been run entirely from the mains of an electricity supply company external to the owners of the mine.

The supply of electricity, which is given by the Distribution Co. at a pressure of 440 volts in the form of three-phase current, 40 cycles, is delivered to the colliery at a separate brick structure containing the main switches and instruments, which are all under lock and key, being accessible only by direct authority of the management.

Messrs. Ernest Scott & Mountain, Ltd., of Newcastle-on-Tyne, carried out the work of conversion. The underground pumps were replaced by one three-throw ram pump delivering 120 gallons per minute against a head of 220 ft. for the main shaft pump, one three-throw pump delivering 200 gallons per minute against 250 ft. head in the five-quarter seam, and two sets of three-throw ram pumps, each delivering 300 gallons per minute against 105 ft. head, for the Brockwell seam. On the surface an electric winding gear and controlling apparatus for the same were installed, together with a new endless rope gear with electric drive; and the original endless rope haulage gear and the fan were also converted from steam to electric drive.

In the winding-engine house the contractors placed a sub-distribution board carrying the necessary apparatus mounted on an enamelled slate base (fig. 1). Perforated metal is placed at the sides and bottom of the switchboard, with a sliding door at one end to give access to the board, so that it is completely protected in accordance with Home Office requirements. Three-core cables carry the current from this board to the various locations; in the case of the five-quarter seam a cable ·2 sq. in. in cross-section, capable of carrying up to 200 H.P., is taken to a junction box placed in the five-quarter seam for the "in-bye" pumps. The current is then conveyed from this point to the shaft bottom by means of cables having a sectional area of ·15 sq. in., with a load capacity of 150 H.P. The shaft cables are secured to the cross buntings by strong wood cleats in such a manner that all the weight of the cable is taken on the cross buntings, without any possibility of transmission of strain to the material of the cable. The wires are insulated with vulcanised bitumen, and armoured with a double layer of galvanised wire. At the shaft bottom a distribution box is placed for the purpose of feeding the main shaft pump, and a switchboard which controls the "in-bye" pumps in the Brockwell

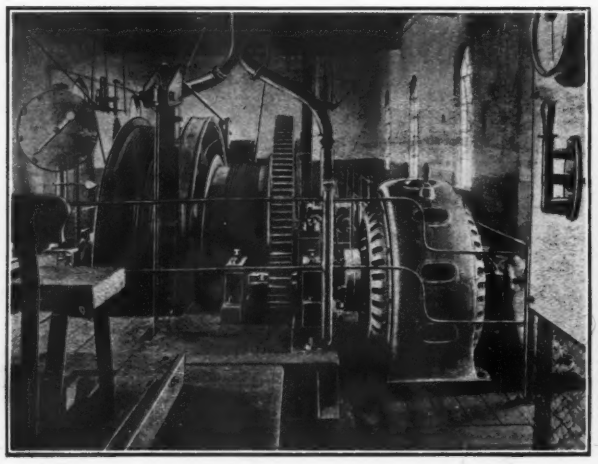

FIG. 4.—ELECTRIC WINDING GEAR.

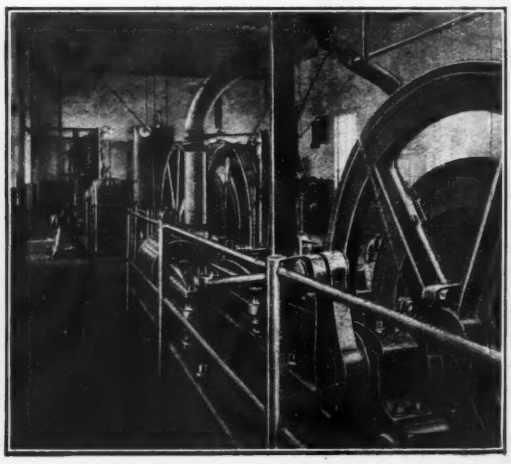

FIG. 5.—OLD WINDING ENGINE, OUT OF USE.

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seam. The type of switchboard used is shown by fig. 2. The pumps used are of Scott & Mountain's three-throw plunger design, mounted on cast-iron girder bedplates, consisting of four longitudinal girders, this arrangement being adopted in order to facilitate handling of the pump beds underground.

The shaft pump runs at 40 revs. per min., and has rams of 14 in. diameter and 18 in. stroke. The virtual head, including pipe friction, is 220 ft. In order to drive this, a three-phase Scott & Mountain motor of 100 effective H.P., running at 580 R.P.M., and taking 120 amperes per phase, was installed. Eight 1¼-in. driving ropes were used to connect the motor to the pump. The switchboard consisted of a slate base fitted with three-pole fuses and ammeter, and a liquid starting switch, the rotor being provided with slip-rings. In the case of the five-quarter seam, the pump capacity is 200 gallons per minute against a virtual head, including pipe friction, of 250 ft., the diameter of the rams being 7 in., and the length of stroke 9 in. The pump runs at 55 R.P.M. when driven by a motor of 25 H.P. by means of an 8-in. belt. In the Brockwell seam the two pumps are each capable of delivering 300 gallons per minute against a virtual head including friction of 125 ft. They are of sufficient strength to enable them to be carried to a total distance of 1,000 yards "in-bye," being equipped with motors each of 20 H.P. running at 500 R.P.M. Belt drive is used, and similar switchgear to the above is installed. The "in-bye" cables are supported by cleats placed at close intervals, and are protected by vulcanised bitumen, together with a heavy covering of jute and compound over all.

The problem of installing the electric winding gear was complicated by the fact that, until the moment had arrived for changing over the mode of transmission, the existing steam winder had to be in continual operation; to enable the conversion to take place the winding house was extended, and the motor put in on the other side of the winding gear to the steam engine. The arrangement as it existed immediately after the change-over is seen in fig. 5, where the original steam plant is still in position but disconnected from the winding gear. Fig. 4 gives a closer view of the electrical equipment, and shows the compactness of electrical drive as compared with the previous steam installation.

The depth of the Brockwell seam is 180 ft., while that of the five-quarter seam is 120 ft., one tub being raised per wind, which when empty weighs 5 cwt. Each tub, however, is calculated to carry 10 cwt. of coal, and the weight of rope is 243 lb., so that the load on the gear is about 22 cwt., or allowing for balance, the maximum-out-of-balance load is, say, 17 cwt. The total time of wind is 20 seconds, 15 of these being occupied in the actual operation of winding, and 5 seconds in banking or unloading the tubs.

The average speed of winding the large drum is 720 ft. per minute and for the small drum 480 ft. per minute, the diameters of these drums being respectively 7 ft. 6 in. and 5 ft. Assuming that the winding was continuous throughout a day of, say, 9 hours, the total amount of coal which could be raised per day would be 810 tons, but in actual practice the amount brought to bank does not come near this. As the colliery develops it is probable that 500 to 600 tons per day will be raised. The motor driving the winding gear has an effective H.P. of 80, with a capacity of taking momentary overloads of 150 H.P. A slow-speed motor was adopted in order to avoid the necessity of getting a motor having high inertia up to high speeds and stopping again, and also in order to avoid the large train of gearing necessary where high-revolution motors are adopted. In this case a little increase in first cost brings about considerable economy in working.

The gearing consists of a forged machine-cut steel pinion, and a cast-iron machine-cut spur wheel on the drum-shaft; this runs very quietly. The braking is accomplished mechanically by means of an ordinary foot brake.

The starting and stopping motion, which is brought down to as mechanically simple a form as possible, consists of a lever, standing in mid position, but capable of being thrown in either direction for raising or lowering. This lever works a relay switch under the floor, which, in its turn, energises the three-pole switch by means of which the direction of running is controlled. The controller, which is in the rotor circuit, is of the liquid type, and is operated by means of a small centrifugal pump and motor which continuously delivers water into the controller tank. The valve at the bottom of the tank is opened or closed by means of the operating lever. As the valve is closed, the level of water rises in the tank and the circuit is completed for the current through the water, causing the motor to start; the opening of the valve again causes the water to flow out and the motor again to stop. The electrodes consist simply of wrought-iron plates.

The conversion of the fan to electric drive was accomplished by taking off the connecting rod of the engine and putting in a shaft having a half-coupling which fitted the crank disk of the engine. On this a pulley was placed, and the fan was driven by means of a motor of 25 effective H.P. similar to the motors used underground (fig. 3).

The endless rope haulage gear is capable of hauling 250 tons of coal per day of nine hours along a road 1,600 yards in length against an average gradient of 1 in. per yard. A machine-cut spur wheel of 59½ in. diameter and 6 in. face, with 75 teeth, 2½ in. pitch, was fitted to the crankshaft of the old engine, and this wheel was driven by a machine-cut steel pinion of 12 in. diameter having 15 teeth. On the countershaft, which bears this pinion, is fitted a rope-driving pulley 6 ft. 10 in. in diameter grooved for five 1-in. ropes, this pulley being indirectly driven by means of a 30-H.P. motor running at 770 R.P.M. The speed of rope attained is 2 miles per hour on a diameter of rope wheel of 6 ft. At one part of the road there is a gradient of 1½ in. per yard against the load.

The old main and tail haulage was entirely scrapped, and a new gear was fitted driven by a motor of 50 effective H.P.

The working costs under the new system, as compared with the old, have proved so satisfactory to the owners of the mines, that they have recently extended their electric equipment.

The Soul Machine.—A singular line of investigation is being pursued by Dr. F. Peterson, Professor of Psychiatry at Columbia University, and Dr. Jung, of Zurich. It appears that if a weak electric current is passed through a person's body from hand to hand, with a reflecting galvanometer in the circuit, any emotion experienced by the subject is at once indicated by a change in the conductivity of the tissues, and a corresponding displacement of the spot of light. This phenomenon, it is said, can be utilised in the detection of crime, to test the validity of evidence, or to identify from a number of suspected persons the guilty one. The experiments have taken the form of mentioning to a subject, who has previously been caused to charge his mind with some incident, a number of words, in response to each of which the subject must utter the first word suggested to his mind thereby. It is found that whenever a word bearing upon the matter is named, the subject experiences an emotional change which at once affects the galvanometer exceptionally; moreover, when the list of words is gone through again, he forgets the responses he gave to the catch-words, whereas a normal subject with no knowledge of the incident concerned experiences no emotion, and remembers his responses. The announcement of the research to the scientific world led to the discovery that the phenomenon in question had been first observed by a Frenchman, Féré, in 1888. Further particulars are given in *Archives of the Roentgen Ray* for April.

The Lötschbergbahn and Padua-Fusina Railways.—Work is being carried on at the present time by the Allgemeine Elektricitäts Gesellschaft, Berlin, in connection with the Lötschbergbahn and Padua-Fusina Railways. For the former, the Berner Alpenbahn-Gesellschaft have ordered an electrical locomotive equipment with two single-phase motors of the Winter-Eichberg type, having a one-hour rating of 800 H.P. The motors are built for a frequency of 15 cycles per second, and the line pressure is 15,000 volts. The normal speed of the locomotive is about 40 km. per hour, and a maximum speed of 75 km. per hour can be attained. The maximum tractive effort is 13,500 kg. The locomotive consists of two parts, each of which has two driving axles, and one running axle; hence, the whole locomotive possesses six axles, four of which are used for driving; the motors are coupled by means of connecting rods to the axles, without any intermediate gears. The Padua Fusina line has a length of about 35 km., and is a single-track line for normal gauge. The line pressure for the major part of its length is 6,600 volts, but a small portion of its length, where the line is entering Padua, has a pressure of only 600 volts. The line is equipped with an overhead catenary suspension. Ten motor-cars and five trailers have been supplied. Each motor-car is equipped with two single-phase motors of the Winter-Eichberg type, each having a one-hour rating of 65 B.H.P. The motors are built for a frequency of 25 cycles per second, and the cars can run either with high or low pressure. On level track they are capable of running at a speed of about 40 km. per hour.

OUR CONTRACTORS' COLUMN.

Commencing with this issue, it is our intention in future to publish this section of the Electrical Review in our advertisement pages. (This week's list of buildings appears on pages 56, 58 and 60.) The constantly increasing demands upon our editorial space, and the fact that this particular matter is intended for immediate use by the electrical contractor and supplies trades, and is not of permanent value for binding up in the half-yearly volumes, have rendered the adoption of this course desirable.

NOTES.

Then and Now—A Stay-at-Home Policy?—We recognise that one of the great handicaps of the Brush Electrical Engineering Co., Ltd., to whose report we allude elsewhere in this issue, has been lack of adequate working capital. But let us see how the gross profits of this year compare with those of the three preceding years:—

1905	...	...	£73,929
1906	...	...	£65,802
1907	...	...	£63,294
1908	...	...	£28,213

At last year's meeting when the profits announced were £63,294, Lord Vaux said:—

"During the last two years, the number of inquiries for tramcars had been very small, and that *had compelled them to cultivate foreign markets*, but they preferred home orders if they could be obtained at fair prices."

At the previous year's gathering, when the profits announced were £65,802, he said:—

"It did seem anomalous to him that, by reason of foreign competition, English manufacturers *should be compelled to seek a large proportion of their trade abroad.*"

The cause is different in the two cases, and the effect the same, but the italicised words are a pitiful expression of a desire to stay at home and not to worry about contracts abroad. How far this policy has been pursued during the past year we are not told in the report, for it does not refer to any foreign business gained, and in the aggregate work done there has been a marked falling off, so that the gross profit has fallen to £28,213! Is this the consequence of that objection to being compelled to "go out"?

At the meeting held in May, 1907, after saying that the producing power of the English factories was far in excess of the demand, resulting in severe competition between the home firms, Lord Vaux remarked:—

"That unsatisfactory state of affairs had led them to pay more attention to foreign contracts, and they had met with a gratifying measure of success in that direction, recent examples of their work now being in operation in South Africa, South America, New Zealand, India, &c. Foreign work, however, entailed greater risks both as regarded the initial expense of obtaining the contract and from a financial point of view. It generally meant that one or more of the company's responsible officers had to visit the country so as to settle the arrangements, and should the company not secure the contract, the expenses that had to be written off were very much heavier than if the work was being done at home."

All this struck us at the time as being very elementary, but it was indicative of an apologetic attitude for desiring to do nothing.

Mr. Garcke at the same meeting said:—

"He was recently in Australia, and he found that the Americans and the Germans . . . . . instead of withdrawing their agents, were increasing them . . . . . Unfortunately English firms did not make sufficient profits at home to enable them to secure the necessary expenditure for pushing their business to the extent that was necessary."

We hope that when in their 1908 report the directors say that they have been led by the reduced demand for the company's staple manufactures "to investigate other openings for activity," they are not overlooking the above remarks made by their own chairman concerning the "gratifying measure of success" obtained in their foreign efforts in a previous year.

The American General Electric Co.—We briefly allude in our leaderette pages to the general result of the last business-year of the General Electric Co., of America. We may here also quote what Vice-President E. W. Rice, jun., says in his report. As quoted in the *Electrical World*, he states that experience in the use of the high electric pressures of from 60,000 to 100,000 volts, needed for the economical distribution of electricity over very long distances, has been so satisfactory that higher pressures up to 150,000 volts are being considered in pending propositions. "In this connection, it is stated that the sales of transformers of 60,000 volts and over in 1908 were nearly double those of 1907. Many improvements have been made in switches for the control of high-tension circuits, and they have designed and placed in commercial operation switches capable of controlling 110,000 volts, which is the highest voltage now in practical operation. Two 14,000-kw. turbines, placed in operation in Chicago, and two in New York, have proved satisfactory in every respect, and orders for additional units of the same size have been received. The company engineers have completed the design of a number of turbine generators for operation by low-pressure or exhaust steam. The economic value of these machines is based upon the fact that steam turbines are much more efficient than steam engines in the lower range of steam pressures between atmospheric pressure and a good vacuum. Turbines of this character have been designed up to 500-kw. capacity, and it is expected that they will, by utilising the exhaust steam from one of the existing engines, increase the capacity of the combined unit more than 40 per cent. with a substantial reduction in coal consumption. The Curtis steam turbine has been adapted to the driving of centrifugal pumps and the City of San Francisco has purchased eight 750-h.p. and four 600-h.p. turbine pumps for a high-pressure water system. This is the first important application of steam turbines to this class of service.

"The new type of commutating pole railway motor has, it is stated, proved most satisfactory in practical operation and large numbers have been sold. Several new sizes have been developed during the year. The 1,200-volt railway system has been further perfected and the installations already made have proved an unqualified success. The vertical type of rotary converters of our design has continued to give satisfaction and many additional installations have been made during the past year. They are of particular value because of the saving in space afforded by the compactness of design. A number of these vertical rotaries is being built of 2,500-kw. capacity, which are the largest rotaries ever constructed. An especially interesting application of electricity is exemplified in an order received during the past year for the complete electrical equipment of two power stations and an electric transmission plant furnishing power and light for the construction of the dam at Gatun, Isthmus of Panama. The order includes 12 special electric locomotives and a number of special motors required for this work."

Central-Station Relations with the Contractor.—At a recent meeting of the Brooklyn (N.Y.) Kilowatt Club at the Brooklyn Edison clubrooms, an address on electrical development was delivered by Mr. T. C. Martin, editor of *Electrical World*, who submitted the following table as evidence of the fact that the central-station industry of the United States was still far from being properly developed, and showed, as a matter of fact, that telephony derived a larger income from the public, the isolated plant business in each field probably offsetting so as to leave the "public utility" figures a fair comparison.

Beginning of 1908.	Investment or capital.	Number of plants or companies.	Earnings.	Net income before dividends.	Total number of employés.
Electric light ..	$996,613,622	4,714	$175,642,338	$41,445,427	47,632
Electric railways ..	3,774,772,096	1,236	429,744,254	40,340,286	221,429
Telephony	814,616,004	22,971	184,451,747	43,659,442	144,169
Telegraphs	220,293,575	25	51,583,868	10,704,255	28,034
	$5,806,295,297	88,946	$841,432,207	$136,149,410	441,264

Mr. Martin laid special emphasis on the desirability of closer harmony and co-operation between the central station and the contractor throughout the country. The average central-station earnings per capita ought to be at least $5. After the address there was a discussion of possible co-operation in Brooklyn between company and contractors, as had been suggested, along the line of the company financing certain contracts entered into by the local contractors and receiving payment therefor on the instalment plan; also of the matter of a possible set of standard specifications for house wiring. Definite action was postponed until another meeting.—*Electrical World*, N.Y.

Cost of Reinforced Concrete Buildings.—At a recent meeting of the Quantity Surveyors' Association, Mr. M. Kahn (Trussed Concrete Steel Co.) read a paper dealing with reinforced concrete structures. Included were tables of cost of fireproof buildings carried out, the cost including a net profit of 10 per cent. to the contractor. From this it appears that the cost per cubic foot of concrete, may be taken for a factory at 5¾d. to 6¼d.; garage, 4¼d.; fire-station, 7¼d.; and cold storage, 6d. The unit cost of concrete per cubic foot, taken as the average of nine constructions was, footings, 10d.; walls above ground, 1s. 2¼d., and below ground, 1s.; columns, 1s. 2¼d.; beams and girders, 1s. 5d.; flat slabs, 1s. 3d.; ditto between steel beams, 1s. 1½d.

As regards the steel reinforcement, if this is built up on the site, the cost of constructing and handling averages £2 10s. 6d. per ton; but if ready made reinforcement were used, the cost averaged only 15s. 6d. per ton.

A Waterproof Motor.—We recently had the opportunity of inspecting a remarkable motor, invented by Mr. W. R. MacDonald, whose success in devising an electric scrubber for cleaning ships' bottoms has made him widely known in naval circles. The motor appears to be as successful as the scrubber; it not only has no objection to a subaqueous existence, but actually prefers it. While we are not at liberty at present to disclose the details of its construction, we may say that no attempt whatever is made to exclude water by means of a water-tight enclosure; on the contrary, the water plays freely through every part of it, without injuring it in the least. All previous attempts to work an electric motor under water, we believe, have resulted in failure; stuffing-boxes are powerless to exclude the water permanently. In certain situations the possession of an absolutely waterproof motor would be of priceless value, and we have no doubt that many uses will be found for this amphibious machine. Mr. MacDonald, as will be gathered from our advertisement pages to-day, is desirous of disposing of the patent rights.

Electrical Engineers in Peru.—In reply to inquiries relating to opportunities existing in Peru for the employment of American electrical engineers, Consul-General Samuel M. Taylor, of Callao, reports as follows:—"The only enterprise in Lima employing an electrical engineer is the Empresas Electricas Asociadas, an American being under contract at a high salary. Other electrical engineers are employed by the society, it is true, but they are all subordinates, at a salary of $75 per month, which seems to be the average paid electrical engineers here. Many applications are received for these positions, especially from Americans and Germans, but Peruvians who have more or less mastered the art, are generally given the preference over foreigners. If American electricians come here it should be under a contract in advance with some good enterprise."—*American Electrical Record.*

Appointments Vacant.—Lecturer in electrical and mechanical engineering (£350) for the Technical College, Dundee. Electrical assistant for the Rawtenstall Corporation Tramways Department (30s.). Deputy manager and chief assistant for Sheffield Electricity Supply Department (£300). Charge engineer for Carlisle Electricity Works (35s.). Electrical engineer and manager for West Ham municipal electrical undertaking (£500 present salary, but the advertisement announces that this is not the limit, and applicants are asked to state desired salary). Particulars appear among our advertisements.

Electrical Contractors' Association (Inc.).—The eighth annual dinner of this Association will be held at the Holborn Restaurant, on Monday, June 14th.

The Steel Makers' Trade.—The *Times* states that at a conference of steel makers and employés, held at Swansea on Monday, it was decided to bring into operation in the trade a general eight-hour day as soon as possible. It is estimated that work will thus be found for 1,400 more men.

Copper in Central Africa.—The holdings of the Tanganyika Concessions Co., a British corporation in British Central Africa, are said to be the most extensive and the richest copper properties ever discovered. It is claimed that these new copper mines will be able to produce the metal cheaper than any others in the world.

Radium in Cornwall.—Sir William Ramsay, consulting chemist to the British Radium Corporation, Ltd., has reported on the pitchblende ore from Trenwith mine, near St. Ives, Cornwall, from which he has extracted radium in an approximately pure state. He recommends the directors to install plant for the regular extraction of the valuable constituents of the ore on a commercial basis.

Institution and Lecture Notes.—The Institution of Electrical Engineers (Glasgow).—The ninth annual report of the Local Section was to be submitted to the general meeting on Tuesday last. It states that the arrangement of papers and the method of dealing with them by the parent Institution in London have been considerably modified, so that Local Sections have now more direct control over the choice of papers to be read at their meetings. Something still remains to be done, however, in the direction of local autonomy. The total membership amounts to 290, practically the same as last year. The office-bearers elected for the ensuing year are as follows:—Chairman, Mr. E. G. Tidd; past chairmen, Messrs. Francis G. Baily, W. W. Lackie; vice-chairman, Mr. Wm. M'Whirter; chairman of students' section, Mr. H. A. Mavor; hon. sec. and treasurer, Mr. James E. Sayers; members of committee, Messrs. J. K. Stothert, Jos. Taylor, Robert Robertson, J. A. Robertson, Dr. J. T. Bottomley, Dr. Magnus Maclean, Mr. Sam Mavor, Councillor W. C. Martin, and Mr. Campbell M'Millan. The Council has arranged to combine with the West of Scotland Iron and Steel Institute in an all-day excursion by steamship on Thursday, June 17th. The Glasgow Students' Section's third annual report has also been issued, showing a satisfactory record for the session.

Junior Institution of Engineers.—At the last meeting of this Institution a paper on "Distributing Systems for the Supply of Electricity" was read by Mr. Charles H. Smith, A.M.I.E.E. After some introductory remarks with reference to determining the choice of the method of supply, the author dwelt on the arrangement of networks, showing the necessity for interconnection at every possible point. The requirements of an efficient system of distribution from a generating station which had to be built a long distance from the centre of load, but not far enough to justify the generation of E.H.T. alternating current were set forth, and questions relating to transformer sub-stations entered into. The birchwood insulating disks devised by the author to enable negative and triple services to be put on "alive" without very serious risk were illustrated, and a specimen exhibited together with other fittings, sections of cables, &c. Practical information was given with reference to armoured and plain lead-covered cables, cheap service connections, methods of laying cables underground, &c. The paper, which is published in the May number of the Institution *Journal*, was a very lengthy one.

Institution of Electrical Engineers (Birmingham).—The annual general meeting of the Birmingham Local Section was held on May 5th. Prof. Gisbert Kapp, the chairman, in proposing the adoption of the report of the Committee for the Session 1908-9, said that the papers had been of a high order, and the members had shown great interest in the discussions. A vote of thanks to the authorities of the University of Birmingham for allowing them to hold their meetings in the University Buildings, and a vote of thanks to Dr. Kapp, were duly carried.

Patent Revocation.—The Comptroller-General of Patents has revoked Letters Patent No. 17,158 of 1896, relating to rim-locks (Yale & Towne Manufacturing Co., U.S.A.). The patentee's agents notified that it had been decided to take no further steps to protect the patent, and the Comptroller-General interpreted this as meaning that the patentee did not propose to contest the application, which, in his opinion, was an admission that the allegations in the application were correct.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station Officials.—A very successful farewell smoking concert was held at the White Horse Hotel, Birmingham, on Friday, 7th inst., in honour of Mr. T. R. J. Orr, late assistant resident engineer at the Corporation Electricity Works, Summer Lane, who has recently resigned his position, after ten years' service, in order to proceed to Australia. An excellent musical programme was provided, and after Mr. Orr's health had been proposed by Mr. Ashlin, of Water Street Station, and seconded by Mr. A. Turner, of the British Thomson-Houston Co., Mr. P. R. Boulton, in the absence of the resident engineer, Mr. J. P. Kemp, made a presentation, which consisted of a suitably-inscribed gold chronograph for Mr. Orr and a silver vase for Mrs. Orr; these were subscribed for by the officials and employés of the electricity supply department and the various contractors' representatives.

At a special meeting of the City of Bradford Electricity Committee on Wednesday evening last week, Mr. Thomas Roles, the electrical engineer, was presented with a dining-room clock on the occasion of his marriage.

Mr. R. M. Moberley, the mains superintendent at Carlisle, having resigned, the engineer recommended that instead of appointing a successor, the work of his department should be re-arranged, that Mr. Thompson, the present station superintendent, should be appointed principal assistant, and that a charge engineer should be appointed to take charge of the station and the running plant at night. The recommendation was adopted, and will result in a saving of from £20 to £25 per annum.

The Shoreditch Lighting Committee has recommended that the salary of Mr. W. Weekes, assistant electrical engineer, be advanced from £200 to £225.

The Leyton U.D.C. has increased the salary of Mr. Speight, station superintendent, from £180 per annum to £200 by two annual increments of £10.

The Blackburn T.C. on May 6th decided to appoint Mr. E. Moxon chief assistant electrical engineer at a salary of £225 per annum as from June 7th, rising by annual increments of £12 10s. to £250 per year, and Mr. G. Turner, senior shift engineer, to be station superintendent at a salary of £175 per year, rising by annual increments of £10 8s. to £206 per annum. It was decided to fill the vacant post of third shift engineer.

We learn that the Tunbridge Wells Corporation at its meeting on Wednesday, May 5th, decided by a majority of 21 to 4 to extend the term of Mr. Boot's present appointment to August 31st, 1909, and after that date to retain him as consulting engineer at a fee of £100 per annum, with 5 per cent. commission on new work. At the same meeting the Council appointed the following:—Mr. J. W. Beauchamp, of Sheffield, resident engineer; Mr. John Bemrose, of Worcester, chief assistant engineer; Mr. Valentine F. Bush, of Tunbridge Wells, junior assistant.

With reference to the recent advertisement for a chief engineer and manager of the Borough of Southwark electric light undertaking, the town clerk asks us to state that the Council has deferred making the appointment for a period of three months.

Tramway Officials.—Mr. F. J. Gosden, of the Brighton tramway staff, who is leaving to take up an appointment under the L.C.C., has been presented by his colleagues with a leather travelling bag and purse.

Mr. A. N. Banister, late of the Norwich tramway staff, who is leaving, has been presented with a silver salver and cake basket.

General.—Many men engaged in connection with the electrical industry will be interested to learn that Mr. H. Bevis has resigned the position of director of the General Electric Co., Ltd.—with which company he has been for over 20 years—in order to take up the position of managing director of Pirelli, Ltd., which, we understand, is being registered here. The name Pirelli, as that of a leading Continental wire and cable manufacturer, is too well known to English electrical engineers to require any introduction here. The firm's business does not consist entirely of cables, it covers motor tires, and, indeed, every article that is composed of india-rubber or gutta-percha. Mr. Bevis asks us to say that he will always be pleased to meet his old friends in electrical circles at his new address, 45, Basinghall Street, E.C.

Mr. John Thomas Cowell, of Douglas, who has been appointed Receiver-General of the Isle of Man, is a director of the National Telephone Co.

We read in the *Times* that Herr D. Spricker, managing director of Messrs. Siemens & Halske, is now in London making arrange

ments for the forthcoming visit of British clergy and professors to Germany.

Mr. Frank Pickering, M.I.E.E, assistant electrical engineer, Cape Government Railways, was married at Cape Town, on April 15th, to Lily, youngest daughter of the late Thomas Greenshields, of Woodstock, Cape Colony.

A gold watch has been presented to Mr. J. R. Reeves by Mr. A. E. Frankling, assistant electrical engineer, on behalf of the officers and men in the Electrical Engineers' Department of Portsmouth Dockyard. Mr. Reeves is retiring after 37 years' service.

On Tuesday Mr. Marconi was admitted a Doctor of Laws of Liverpool University, and the honorary degree of Doctor of Engineering was conferred upon the Hon. C. A. Parsons.

NEW COMPANIES REGISTERED.

Robinson & Carter, Ltd. (102,864).—This company was registered on May 5th, with a capital of £1,000 in £1 shares, to carry on the business of electricians, engineers, manufacturers and workers of electricity, &c. The subscribers (with one share each) are:—R. Carter, 5, Thomas Street, Liverpool, electrical engineer; H. W. Robinson, 5, Thomas Street, Liverpool, electrical engineer. Private company. The number of directors is not to be less than two or more than five. C. A. Robinson is permanent governing director; remuneration as fixed by the company. Registered by T. T. Hull and Son, 22, Chancery Lane, W.C.

Davey Electric Co., Ltd. (102,814).—This company was registered on May 3rd, with a capital of £2,000 in £1 shares, to carry on the business of electrical, mechanical, and general engineers, manufacturers of and dealers in electric lamps, electricity meters, electrical switches, cut-outs, and other electrical apparatus, &c. The subscribers (with one share each) are:—W. Martin Davey, Tower Building, Liverpool, consulting engineer; J. Andrews, 20, North John Street, Liverpool, accountant; C. F. Heard, Tower Building, Liverpool, consulting engineer; J. Wilson, 28, Chapel Street, Liverpool, engineer; C. P. Boucher, 28, Chapel Street, Liverpool, engineer; H. R. Jones, 24, Belgrave Street, Liscard, Cheshire, electrical engineer; S. R. Wilson, 16, Hampden Road, Higher Tranmere, Birkenhead, electrical engineer. Private company. The number of directors is not to be less than two or more than four; the first are not named; qualification, £100. Registered by T. T. Hull and Son, 22, Chancery Lane, W.C.

Wardle Engineering Co., Ltd. (102,714).—This company was registered on April 27th, with a capital of £5,000 in £1 shares (2,000 preference), to carry on the business of electrical and mechanical engineers, suppliers of electricity for light, heat, motive power or otherwise, &c. The subscribers (with 100 shares each) are:—C. Wade, Kirk Ella Hall, near Hull, gentleman; C. H. K. Chamen, 112, Portland Street, Manchester, engineer. Private company. The first directors are not named; qualification, 100 shares. Registered office, 112, Portland Street, Manchester.

Mountain & Gibson & Thornewill, Ltd. (102,873).—This company was registered on May 6th, with a capital of £150,000 in £1 shares, to acquire the business carried on by Mountain & Gibson, Ltd., at Elton Fold Works, Bury, and to carry on the business of civil, mechanical, electrical, railway, tramway, marine, lighting, ventilating, consulting and general engineers, founders, machinists, builders and contractors, suppliers of electricity, manufacturers of and dealers in railway, tramway and road locomotives, carriages, cars, motor-cars, chassis, omnibuses, trucks, cycles and vehicles, &c. The subscribers (with one share each) are:—M. B. Mountain, Eldon Grange, Bury, engineer; G. M. Gibson, Charlton Manor, Knaresborough, engineer; G. L. Walker, 49, Queen Victoria Street, E.C., engineer; J. D. Tetley, Palace Chambers, Westminster, S.W., Parliamentary agent; H. L. Bankes, Orient House, New Broad Street, E.C., clerk; J. H. Hyland, Orient House, New Broad Street, E.C., clerk; H. P. Geard, 144, Boyson Road, S.E., articled clerk. Minimum cash subscription 100 shares; the number of directors is not to be less than three or more than seven; the first are R. Thornewill, J.P., M.I.M.E., Craythorne, Burton-on-Trent; E. D. Simon, B.A., A.M.I.C.E. (Henry Simon, Ltd.), 20, Mount Street, Manchester; M. B. Mountain, C. Spalding, Burton-on-Trent; G. M. Gibson, B.A., A.M.I.C.E.; and N. M. Lawrence (director of Mountain and Gibson, Ltd.), 82, Cambridge Terrace, Hyde Park, W.; qualification, £250; remuneration, £100 each per annum. Registered office, 49, Queen Victoria Street, E.C.

National Telewriter Co., Ltd. (102,859).—This company was registered on May 5th, with a capital of £300,000 in 210,000 preferred ordinary shares of £1 each and 90,000 deferred shares of £1 each, to acquire upon terms of an agreement with the Telewriter Syndicate, Ltd., the patents and licences and the benefit of certain agreements in connection with the use of the telewriter and other property and rights and to carry on the business of manufacturers of, and dealers in, dynamos, wire cables, insulating materials, accumulators, telephones, telewriters, telautographs and other apparatus, electricians, engineers, &c. The subscribers (with 500 preferred ordinary shares each) are:—Sir William P. Treloar, Bart., 68-70, Ludgate Hill, E.C.; A. R. Prideaux, Goldsmiths' Hall, London, solicitor; Sir John G. Craiggs, Kt., M.V.O., 3, London Wall Buildings, E.C.; E. B. Ellice-Clark, Gore Court, Maidstone, M.I.C.E.; E. W. W. Edwards, 19, Lewes Crescent, Brighton; J. Liddell, 46, Sussex Square, Brighton; R. T. Parkin, 117, Cannon Street, E.C., solicitor, one share. Minimum cash subscription, 75,000 preferred ordinary shares. The number of directors is not to be less than five or more than nine; the first are Sir William P. Treloar, Bart., A. R. Prideaux, Sir John G. Craggs, Kt., M.V.O., E. B. Ellice-Clark, E. W. W. Edwards, J. Liddell, and Sir Albert K. Rollitt, LL.D., 3, Mincing Lane, E.C.; qualification, 500 shares; remuneration, £2,500 per annum and a share in the profits (maximum in any year £5,000) divisible. Registered office, 4, London Wall Buildings, E.C.

CITY NOTES.

Brisbane Electric Tramways Investment Co., Ltd.

Mr. H. R. Beeton presided at the annual meeting held recently in London. He congratulated the company upon a continuance of favourable conditions in the colony, and upon another record year. Comparing the combined figures of the two companies, the total receipts amounted to £178,602 in 1908, as compared with £159,230 in 1907, showing an increase of £19,372, and the total expenditure amounted to £94,154 in 1908, as compared with £88,117 in 1907, showing an increase of £6,037, so that in the past year there was an increase in net profit of £13,335 as compared with 1907. The Brisbane Tramways Co., of which they held all the shares, after placing a sum of £18,000 to its renewals fund, and so raising the aggregate of renewals, reserve funds, and undivided profits in both companies to £76,227, had paid in dividend £65,000, as against £57,000 for 1907. This enabled this company to satisfy its debenture stock interest and preference share dividend, and to recommend a dividend on its ordinary shares of 3s. 6d. per share, free of income-tax, making, with the interim dividend of 2s. 6d. paid in November, a total dividend on these shares of 6 per cent. for the year. The growth of traffic was so remarkable as to call for more than passing notice. During the past year the passengers carried amounted to more than 200 times the whole population of Brisbane and suburbs, representing an increase of 12 per cent. as compared with 1907, and as the car-mileage run only increased 1 per cent., the gross receipts per car-mile increased from 11·40d. in 1907 to 12·66d. in 1908. The traffic receipts had increased by 40 per cent. in the past four years and 25 per cent. in the past two years, and they continued to grow. For the first quarter of the present year they showed an increase of £3,110 over the first quarter in 1907, which again showed an increase of £5,556 over the first quarter in 1906. Moreover, as the mileage run during the past three months was nearly 20,000 less than in 1908, the car-mileage receipts during this period had increased from 12·43d. to 13·66d. Too much credit could not be given to Mr. Badger, the general manager. The receipts this year were likely to be assisted by the celebrations in Brisbane of the fiftieth anniversary of the birth of Queensland as a separate estate. The chairman dwelt upon the wonderful developments that were taking place in the colony and its favourable prospects for investors. The company's compensation claims were very small, amounting to only £500. The question of wages was an important one to them, representing £67,000 out of their total expenses of £94,000. The sale of electric power showed a gratifying increase, and with the plant now at their disposal, it was intended to push the lighting and power business more vigorously in the immediate future.

Mr. J. B. Concanon seconded, and the report was adopted.

Musselburgh and District Electric Light and Traction Co., Ltd.

—The report states that the balance to the credit of the net revenue account is £3,904, plus £119 brought forward. Deducting interest on debentures, &c., there was a balance of £1,611. The directors recommend appropriating to reserve and renewals fund—tramways £400, lighting £200—paying a dividend on the preference shares for the year at the rate of 2 per cent. on £880, and carrying forward £131.

Swansea Improvements and Tramways Co., Ltd.

—The report for the half-year ended December, 1908, states that the gross receipts amount to £27,362. After deducting all expenses chargeable to revenue, including debenture and other interest and amount payable to the Corporation in respect of tramways and light railways leased from the Corporation, and after charging profit and loss accounts with £2,500 for provision for renewals, there remains a surplus of £4,951, plus £3,809, brought forward. There is placed to depreciation and reserve account, £2,000; to dividends on 5 per cent. and 6 per cent. preference shares, £1,299; to dividend on 13,000 ordinary shares, 3 per cent. for the year, £3,900; carrying forward £1,561. The expenditure on capital account during the half-year was £580. The Mumbles Railways and Pier undertaking showed gross receipts amounting to £24,143, and expenses, £23,570; the net profit being £573, was payable to the B.E.T. Co., on account of interest on moneys provided by them.

Tramways and General Works Co., Ltd.

—The report for the year ended March 31st shows a profit for the year of £979. The directors recommend a dividend at the same rate as for the last two years—namely, 1s. per share, leaving £198 to be carried forward.

West India and Panama Telegraph Co., Ltd.

—In their report for the six months ended December 31st, 1908, the directors state that the amount to the credit of revenue, including £2,000 transferred from income-tax account, is £34,872, against £37,262 for the corresponding half-year of 1907, and the expenses have been £22,160, against £23,028. The result is, therefore, a balance of £12,712, to which is added £1,467 interest on investments and £1,132 brought forward, making an available total of £15,310. The directors recommend dividends of 6s. per share on the first preference shares for the six months to December 31st (£10,363), and 18s. per share on the second preference shares on account of dividends accrued to December 31st, 1908 (£4,202), carrying forward £739. The traffic receipts for the six months show a decrease of £3,231, as compared with those for the corresponding period of 1907. The cables continue to be maintained in good working order.

Meetings Held Over.—Owing to pressure upon our space, reports of several telegraph companies' meetings are held over until next week.

France.—La Société de l'Accumulateur Tudor, of Paris, is declaring a dividend of 7 fr. per share for the last financial year.

The City of Birmingham Tramways Co., Ltd.

The ordinary general meeting was held on Thursday of last week at the Electrical Federation Offices, Kingsway, Mr. C. Shirreff Hilton presiding in the absence of the chairman of the company, Mr. E. Garcke.

In moving the adoption of the report the Chairman, after remarking that Mr. W. Neale, one of the retiring directors, did not offer himself for re-election owing to the state of his health, said that the year had been a comparatively uneventful one. Last year the chairman told them that the total paid-up capital of the company, plus debentures and the amount due to sundry creditors, was £616,224, while the liquid assets amounted to £552,610. The corresponding figures this year were £653,324 and £597,400, that was, their accumulated funds were within £40,000 of their total paid-up capital and obligations. The only investment which caused any anxiety to the board was that to which the chairman referred last year, and to which the auditors had referred this year in their certificate—the Motor Omnibus Co. That business was a relic of the old motor-omnibus business, and to-day it did not pay, especially in face of the competition from the Corporation tramways. The business had been very carefully looked after, and in the opinion of the directors they were doing the best that could be done by carrying it on rather than doing away with it altogether at the present moment. He thought they might take it that the financial position, on the whole, was a very strong and sound one. The traffics for the year were less by £2,262, which decrease was nearly entirely on the cable route, and was due to the competition of the neighbouring Corporation tramways. The electrical lines had, on the whole, maintained their position fairly, but the results on the Bristol and Pershore roads were disappointing, partly owing to competition and partly to the reconstruction which took place during the year. The expenses while they showed additions under certain heads owing to the increased mileage and rentals paid to local authorities, on the whole showed a decrease of £5,594. A large portion of that decrease was due to the lesser amount they had had to pay for insurance, but they could not always expect to be so fortunate in that respect, the past year having been exceptionally free from claims. The net result was an improvement of £1,200 in the amount transferred from the profit and loss account to the balance-sheet. During the year the company's loans were considerably reduced owing to the lesser amount which it was possible to obtain for investments of that kind, but, on the other hand, a corresponding amount had been invested more permanently, with the result that the return had been maintained at about the same level. No leases had expired since the last meeting. It was very much to be regretted that they were unable to come to a friendly agreement with the Council of Handsworth for the sale of the lines to them, but, at the last moment, they thought it was in their interests to break off the negotiations and to apply for an arbitrator, and the matter would go to arbitration in June. When those lines had been purchased and paid for, they would be leased to the company until 1911.

Mr. J. A. Christie seconded the motion, and the report was adopted.

On the proposition of the Chairman, Mr. W. Neale, on his retirement as a director, was voted one year's fees.

The Urban Electric Supply Co., Ltd.

The annual general meeting of the shareholders of this company was held on Wednesday last week at Salisbury House, London Wall, Mr. P. D. Tuckett, the chairman, presiding.

In proposing the adoption of the report (see Electrical Review, April 30th, page 731), the Chairman said he regretted to say that the results for the past year had not realised the expectations they entertained a year ago, and, in some respects, they must be considered disappointing. Under the conditions prevailing last year, however—conditions which had adversely affected almost all other electric supply undertakings equally with theirs—he did not think that the disappointingly slow rate of progress made during the past year need occasion any unduly despondent estimate of their future progress. Progress could, he feared, never be otherwise than slow with towns so small or poor as most of those they supplied, but he saw no reason why it should be as slow as on this occasion, and, indeed, but for the untoward set-back at Hawick and Twickenham, representing, as it did, a reduced profit of £1,464 as against the annual increase of something like £2,000 to which they had become accustomed from those two towns, their progress on this occasion would not have appeared unsatisfactory. Apart, however, from the special circumstances affecting these two particular towns, the returns generally had been adversely affected by three main causes: first, the exceptionally fine weather of the past year; secondly, the trade depression throughout the country; and thirdly, the increased use of metallic-filament lamps. The very general adoption of those lamps in shops, and to some extent in other premises, had distinctly tended to restrict consumption; but, whatever immediate drawback might on this account attach to their adoption, they undoubtedly established electric lighting on a far surer foundation, and, as he told them a year ago, they believed that the ultimate effect of their introduction would be all in their favour. In the meantime they still hoped that their adoption by their existing consumers would be spread over a sufficiently long period to enable them to more than make good by new connections any immediate loss so involved. In spite of the reduced rate at which profits had increased, steady progress continued to be made. During the year they connected the equivalent of 34,906 33-watt lamps, or 8·6 per cent. of the previous total, and although this was at a slower rate than formerly, that was only to be expected when they reflected that each year the scope for profitable expansion was necessarily restricted. Moreover, with the increasing use of the new lamps, they required to connect a larger proportion of consumers than formerly to give them an equivalent load, although the increased standard of lighting, in most cases accompanying their adoption, would go some way towards counteracting this tendency. Except in special cases, the tendency year by year must be to restrict their field for expansion of business. Thus in 1905 they connected the equivalent of 79,955 33-watt lamps; in 1906, 54,309; in 1907, 52,957; and last year, 34,906. Similarly, their profits increased by £6,902 in 1905, by £5,163 in 1906, by £3,324 in 1907, and by only £2,381 last year. During the same period their capital expenditure had been: For 1905, when original construction work was still taking place, £148,000; for 1906, £41,000; for 1907, £38,000; and last year, £17,817, an increase of 1·6 per cent. only, on which the increased profit of £2,381 showed a return of 13·3 per cent. This progressive decline in the rate of expansion of the business afforded no occasion for alarm, since he had already intimated that the diminished rate of increase of profit this last year was due to special and definite causes, from the effect of which they might hope to escape, at any rate in part, in future years. As the business was built up, it would be none the less stable because it expanded at a slower rate, should such prove to be the case. It would involve the expenditure of less capital, a consideration of some importance to the company, whilst he saw no reason to anticipate anything but a steady improvement in the net return. Of course, they would always welcome openings for new and profitable business, and would lose no opportunity of taking advantage of any that offered, since new business wisely undertaken meant increased profit, and in several of their undertakings there was every reason to anticipate a steady and gratifying increase of business—but four of their 13 undertakings served towns with populations of less than 10,000, and only three of those towns with populations of over 20,000, of which Glossop with a population of 21,000, consisting almost entirely of mill operatives, was one, so that, as he had already remarked, the scope for expansion was decidedly limited and every additional £100 took a deal of getting. In comparing the results of the past year with those of previous years, it must not be forgotten that the more rapid increase of profits formerly shown was accompanied by a correspondingly rapid increase of capital, and he had no doubt that all the reductions to which he had referred, especially the reduced lamp connections and capital expenditure, were to some extent due to the policy which he mentioned last year of restricting free wiring to the smallest possible dimensions. That item was increased by a net amount of no more than £1,181, as against £4,846 in the previous year, and £11,366 in the year previous to that, whilst for the current year he hoped the amount might be still further reduced. Turning to the accounts the amount to be carried down to net profit and loss account was increased by £2,224 as compared with the previous year. In the balance-sheet, share capital and debenture debt remained the same, the only other item on the liabilities side, to which he need refer, being the "amount due to contractors," which had increased by £20,555 in consequence of the increased capital expenditure during the year, which had amounted to £17,817. The item "wiring and motors on hire in suspense" was increased this year by £1,444, and, as he pointed out a year ago, it was a most unsatisfactory item and was likely to be an annually recurring one. They had over £133,000 sunk in wiring and motors on consumers' premises, and every year owing to the pulling down of such premises, owing to the abandonment or removal of a business from the premises in which it had hitherto been carried on, or for some other reason, they were bound to incur this loss, and not improbably in increased amounts. Coming to the profits earned at the various towns, he would point out that there must always be some tendency to a seesaw movement in the results shown by any particular town. If special circumstances had contributed to make any particular undertaking show either a good or a bad result in any one year, the tendency would be for it to reverse the process in the following year—although, of course, it did not at all necessarily follow that it would be so—and that was peculiarly the case this year. The two towns, Newton Abbot and Caterham, to the poor results from which he particularly called attention last year, this year showed up well in comparison, but in neither case was the improvement at all largely due to growth of business. Similarly, with Godalming, Dartmouth, and Newbury, a poor result last year was followed by a good one this year. On the other hand, both Hawick and Twickenham showed miserable results this year after consistent progress during the past few years, whilst Grantham had gone back after rapidly pushing ahead in the previous two years. The smallness of the business in the case of the smaller towns rendered the results peculiarly susceptible to unforeseen and unavoidable fluctuation. The death or removal, or temporary absence of one large consumer, the slack trade of a large power consumer, a breakdown involving an expensive repair, or many a similar circumstance, might go far towards turning a normal increase into a decrease; and *vice versâ*, the absence of any of these circumstances might account for an abnormal increase. Thus, after five years' working, Caterham has a total gross revenue of less than £1,900 with an output of 82,000 units, and a maximum load of 70 kw. only, whilst neither Caterham nor Berwick had 300 consumers. It worked out all right on the average over the whole group, because the volume of business taken together was sufficient to adjust the equilibrium and compensate for these individual fluctuations, thus affording the stability characteristic of a large business, and that was one of the reasons why this method of combining a number of small undertakings in one company was obviously the correct one,

but, unless a comprehensive view of this kind was taken, and unless progress was reviewed in the light of previous progress, any conclusions drawn from the results of a particular year at a particular town were likely to be quite unreliable. Analysing the results obtained at the various towns, he said that the five which had gone back were Hawick, Twickenham, Grantham, Glossop and Berwick. Hawick, after consistent progress from the start, showed a decreased profit this year of £608. At Twickenham the decreased profit was £856; Grantham showed a drop of £110, Berwick a reduction of £122, and Glossop of £465. The towns showing increases were:—Godalming, £695; Dartmouth, £617; Camborne and Redruth, £837; Newton Abbott, £882; Caterham, £450; and Newbury, £354. The Stamford and Weybridge undertakings continued to make steady progress, and called for no special comment. Having spoken with satisfaction of the loyal and efficient services of the staffs at the various stations, the chairman, in concluding, said it was true they had shared the common experience of similar businesses in failing to realise the expectations they entertained a year ago, and it might be that the definite and special causes from which they suffered last year would, to some extent, continue to affect them this year, for, in spite of the Chancellor of the Exchequer's comforting assurance that he saw indications of trade revival, he could not think that his efforts were calculated to stimulate the process. Be that as it might, trade could not always remain depressed, the sun could not always be causing them mental anguish by perpetually shining to the detriment of their pockets; and, therefore, although he did not say the improvement would come all at once, he did say there was every justification for believing that future progress would again be more rapid than it had been this year. In the meantime, he could assure them, that in the opinion of the board, the business rested on a far surer and more solid foundation than it did. They believed it to be increasingly stable, and steadily progressive. Their path of progress might not be too smooth, but progress they would, for the industry was still young and the possibilities of development were far from exhausted.

Mr. H. B. Grotian, in seconding the resolution, said he was confident that the right policy for the board was as outlined by the chairman—to continue to keep capital expenditure as low as possible, and to scrutinise very carefully every item of expense.

Mr. Hedges said the shareholders had good cause to blame the directors of Edmundson's Electricity Corporation for the present position of the company. They had taken them into unproductive towns, and had saddled the company with enormous capital at a tremendous expense. As to the future, he thought they should reduce the expenditure of the board. It was absurd to spend £1,000 a year to five directors to manage the company. He believed that the solution of the difficulty would be amalgamation.

A Shareholder: I hope not. We have got a sound concern here and we do not want to get tied up with a rotten one.

The Chairman, in reply, said it was not true to say that the board were virtually governed by Edmundson's Co. As to directors' fees, was it suggested that £200 a year each was too much for them for managing the company's affairs?

The report was then adopted.

Brush Electrical Engineering Co., Ltd.

The directors in their report for the year ended December 31st, 1908, state that the property account has been increased by £8,061 for additions to buildings and plant. An issue was made of £100,000 (part of an authorised issue of £125,000) 5 per cent. prior lien debenture stock specifically secured upon the freehold and leasehold lands, buildings and fixed plant of the company at Loughborough, and by a third floating charge upon the assets and undertaking of the company generally. The general profit and loss account shows a gross profit of £28,213. After debiting general charges and maintenance, the amount carried to net profit and loss account is £2,614. Debenture and other interest charges have absorbed the sum of £17,798. To this amount the directors have thought it well to add a sum of £24,174 to meet bad and doubtful debts and depreciation of stocks. The directors propose to apply the sum of £10,229 standing to credit of general reserve account, towards writing off the loss on the year's working, and to carry forward the debit balance of £29,128. The year under review has been one of exceptional trade depression in which the engineering industries have been especially affected, and the directors much regret that the company's operations for the period have resulted in a loss. The aggregate of orders secured by the company during the first part of the year was below the average, but it was expected that in accordance with previous experience, the results for the latter part of the year would help to counteract this shortage. Unfortunately, this was not realised, and the concluding months showed a further marked falling off in the volume of business. The working expenses and establishment charges of the company have, in spite of the abruptness with which trade declined, been substantially reduced, and important economies have been realised, the full effect of which, however, does not appear in the accounts for 1908. The directors and management are continuing their efforts in this direction, and the general charges for the current year show a large diminution as compared with those for 1908. The shortage of orders has aggravated the already keen rivalry amongst home manufacturers engaged in the electrical industry, and with powerful competition from abroad to contend with in addition, prices have ruled low. On the electrical engineering side, the company's business has been adversely affected by the general adoption of metal-filament lamps. By the use of this new type of lamp a great economy in current is effected. While its advent should, therefore, be highly beneficial to the electrical industry in the long run, the immediate effect has been to leave many electricity supply undertakings with a surplus of power, thus temporarily checking the orders for additional plant that in the normal course of events would have been required. Negotiations are in progress to acquire selling rights of a well-tried and highly successful metallic-filament lamp. On the car side, the demand for tramcars was small during the year, and there has been a noticeable lapse in the promotion of tramways and light railways in the United Kingdom. Orders for main line rolling stock have also been scarce. The reduced demand for the company's staple manufactures has led the directors to investigate other openings for activity in the industrial applications of electricity, and the company's experts are engaged on developments in special branches which hold out encouraging prospects. The business so far secured in the present year shows a marked advance in comparison with a similar period in 1908, and the directors hope that this improvement will be maintained. At the last general meeting Mr. E. Garcke was elected a director, and it was announced that he would assume the chairmanship. Owing to various pending matters which it was desirable to complete, some delay has been unavoidable in making this change, but Mr. Garcke will take the chair after the general meeting.

Elmore's German and Austro-Hungarian Metal Co., Ltd.

The directors in their report submit the accounts of the company and those of the Metall Co. for the year ending December 31st, 1908. The only alteration in the accounts of this company is that the amount of 8 per cent. debenture stock has during the year been reduced by the redemption of £5,778 10s., and that the loan to the Metall Co. has been reduced by a like amount.

Once again the directors have to report an unsatisfactory year, which is all the more disappointing, as it was hoped that, with the greatly improved method of production which has been instituted, coupled with the installation of the most up-to-date plant, the net result would have been a much greater profit than obtained in the previous year; but the continued decrease in trade, with the natural increase in competition, resulted in a reduction in the selling price, which more than absorbed the saving which had been effected in the profit and loss charges on account of general expenses and interest. There was an increase in the weight sold and a decrease in the cost of production, otherwise the company would have had to face a considerable loss. The financial position of the company has, however, improved, and there has been a decrease in the amounts due to sundry creditors and on account of bills payable, while at December 31st last the amount due to Messrs. Sal. Oppenheim, Junr. & Co. had been reduced by £2,500, and has since been further decreased by £2,500, making £5,000 in all, such sum being in addition to the redemption of the debenture stock by the Austrian Co., and also in addition to the amount spent on capital account for additions to plant, buildings, &c., during the year. The directors realise that so long as the present cut prices are in force, the only alternative is to increase the sales and so reduce cost of production, and this has been done to a considerable extent, the sales to date showing an increase of 15½ per cent. in weight. M. 25,422·74 has been charged to repairs and maintenance, in addition to the amount deducted by way of depreciation, and the amount standing to reserve (M. 60,797·23) has since been further augmented by the addition of M. 9,083·99, making a total of M. 69,881·22 standing to the credit of that account.

The amount standing to the credit of profit and loss in the Austrian Co.'s balance-sheet being only £389, the directors regret their inability to declare a dividend upon the company's shares. Messrs. Macfarlan, Heal & Garnet have again waived £275 of their fees for the year.

Prospectuses.—*National Telewriter Co., Ltd.*—The list was to close yesterday in an issue at par of 180,000 preferred ordinary shares of £1 each in this company, which, acting under a 21 years' licence from the Postmaster-General, intends to install public telewriter exchanges for the transmission of telewriter messages, including telephonic messages in relation or supplementary thereto. Sir W. P. Treloar is chairman, and the list of directors includes Sir A. K. Rollit, a director of the National Telephone Co., and Mr. E. B. Ellice Clark, a director of the Edison and Swan Co.

Melbourne Electric Supply Co., Ltd.—On behalf of this company there have this week been offered £100,000 5 per cent. first mortgage debenture stock at 93 per cent. and 20,000 7 per cent. first cumulative preference shares of £5 each at par, for the purpose of adjusting the capital account, as mentioned at the recent meeting of the company.

Dominion Mica Corporation, Ltd. (Canada).—Subscriptions have this week been invited for 7 per cent. first mortgage profit-sharing debenture stock in this corporation, at par.

Rio de Janeiro Tramway, Light and Power Co., Ltd.—The directors are offering a new issue of 62,500 shares at par to existing shareholders.

Cape Town Consolidated Tramways and Land Co., Ltd.—The report for the year ended December 31st, 1908, states that a balance of £516 is shown to the debit of profit and loss account for the current year, making the total to the debit of profit and loss account, £1,228. Neither the estate companies nor the Camps Bay Tramway Co. have been able to declare any dividends for the year now concluded. The Camps Bay Tramway Co., Ltd., has again to record a loss on its operations, the amount on the debit side of profit and loss being £2,232.

West Coast of America Telegraph Co., Ltd.

The meeting of this company was held on Tuesday at Electra House. Sir John Denison-Pender, K.C.M.G., in proposing the adoption of the report (see Electrical Review, May 7th, page 772), said that the gross receipts showed a decrease of £9,242. The reduction was on account of the international traffic having fallen off owing to the stagnation of trade, and also to a falling off in the local traffic, chiefly due to the earthquake at Valparaiso, and the effects that catastrophe had had on the general business of the company. With regard to the working expenses there was a reduction of £1,426. The decrease in the electrical expenses entirely depended on the renewal of instruments, or having to put fresh instruments on to circuits, which cost money, and they had not had to do either of those in the past 12 months. The material item which had caused a reduction in the expenses, was that during the past year they were fortunate enough to get a charter for their repairing steamer, which gave them some £1,500. Six interruptions to cables took place during the year, which lasted for 57 days. That was a very considerable time, and was owing to the fact that at least three of the interruptions occurred in February, and, therefore, the steamer had to do one repair at a time. If the interruptions had taken place at various times when the steamer was free and ready to go at once and do the repairs, the time would not have been so long. At the last meeting he referred to the new steamer which it was necessary to build and put on their station. Within the last four months the directors had accepted a contract from the Goole Shipbuilding Co. to build a steamer which would be engined under the same contract by Richardsons, Westgarth & Co., and they hoped within the next six months to have that vessel on the station at a cost of something under £20,000, which was a very moderate price for the ship they were getting. As to the future, he could only say that their adversaries had given notice of a reduction of the rates to Chile, Peru and Bolivia, which came into effect on May 18th. It was too soon for him to say how that reduction would affect their takings.

Sir Albert J. Leppoc Cappel, K.C.I.E., seconded the motion.

Mr. Lyth complained of the smallness of the dividend. He said the directors were piling up the reserves which had now reached something like £80,000, while the amount paid in dividends was only between £2,000 and £2,500. He hoped the board might see their way to increase the distribution in the future. The shareholders had reduced their £10 shares to £2 10s., and so they were really only getting 2½ per cent.

The Chairman replied that the directors were doing the best they could for the company and the shareholders. A good many years ago they were working in conjunction with a company, which, when it got on its legs largely through its association with them, threw them over, with the natural result that their working expenses were materially increased. In one case, certainly, it resulted in their having to put a ship on the station, instead of one ship doing the work of two; and laying competing cables. That, in 12 months, brought the company down from a very prosperous one to a company that was not paying a dividend. All that occurred before any of the present members of the board were associated with the company. The Western Telegraph Co. came forward and materially helped the company—in fact, had it not been for that assistance, he doubted whether it would be in existence to-day. As to the reserve, the actual reserve was only £66,000. plus £12,000 the ship's reserve. This year they had got to find about £20,000 to pay for the new ship—which sum would, of course, be reduced by any credit they might get from the sale of the old one. The policy of the board was to gradually increase the reserve, and he thought they must allow that to be continued for some time before they talked of increased dividends. They had their debentures and income bonds to meet, but their position was getting stronger, although he admitted that the improvement was slow.

The report was then adopted.

Eastern Extension, Australasia and China Telegraph Co., Ltd.

The half-yearly meeting was held on Tuesday at Electra House, Sir J. Wolfe Barry presiding.

The Chairman, in proposing the adoption of the report (see Electrical Review, May 7th, page 772), said that the gross revenue showed an increase of £2,473, but that increase, unfortunately, was more apparent than real, seeing that the revenue for the past half-year included £10,000, which the company earned over the Tasmanian cables in previous years, but for which the Australian Federal Government refused to account until they were compelled to do so by the decision of the High Court. If this exceptional revenue were deducted the figures showed an actual decrease for the half-year of nearly £8,000, which was due to the commercial depression that had prevailed for some time past in all parts of the Far East. He was, however, inclined to think, from slight indications of improvement recently noticeable in the Straits Settlements and elsewhere, that they had seen the worst of this commercial depression, and he ventured to hope that before very long the financial situation in the countries served by their cables would improve. The working expenses showed a decrease of £2,696. The balance of cost of the Java-Cocos cable, amounting to £8,710, had been debited during the past half-year to the general reserve fund, together with £1,519 for the partial renewal of the Singapore-Banjoewangie cable, leaving to the credit of this fund £1,034,345. It would have been seen from newspaper references to the subject that the company's cable steamer *Patrol* was unfortunate enough to run on to a shoal when proceeding last autumn to a cable repair in the Netherlands Indian Archipelago. Thanks, however, to the valuable help rendered by the Netherlands Indian Government in promptly sending one of their warships to the assistance of the *Patrol*, and to the other facilities available at the time, the cable steamer was got off the shoal in a comparatively short time, without sustaining any material damage, and at a very small cost to the underwriters. They desired to record their acknowledgments to the Netherlands Indian Government for their assistance. When addressing them six months ago he referred to the company's unsatisfactory relations with the Australian Federal Government, and to the necessity for closing their Tasmanian stations when the concession giving them exclusive rights of cable communication between Australia and Tasmania expired, unless some arrangement were previously made with the Government on the subject. Unfortunately, the latter event had not taken place, and their Tasmanian stations were, therefore, closed on the 30th ult., when the concession expired, and the two cables recently laid by the Government between Australia and Tasmania were opened for traffic. The cable communication between those countries was, consequently, now carried on by the Government, and their cables would be picked up when a suitable opportunity occurred, in order that they might utilise them elsewhere.

The report was adopted.

Mr. Lythe asked whether the directors would not make the distribution of the dividend and bonus in the same manner as the Western Telegraph Co.? At present, he said, they paid 2s. 6d. per share during three quarters of the year and 6s. 6d. in the remaining quarter. The bonus had now come to be regarded as part of the dividend, and it would be a convenience to the shareholders if a larger portion was paid in the first three-quarters of the year and a smaller portion in the last quarter.

The Chairman promised that the matter should be considered before the next meeting, but he said he could give no promise that the suggestion would be carried out. The company had in the past gone through bad times, and, therefore, they could not look upon the bonus as being assured, although he was glad to say that, in spite of competition, they had been enabled to keep it up for many years.

South Staffordshire Tramways (Lessee) Co.

Mr. W. S. Schuster, presiding at the meeting of this company, stated that the overdraft was now £2,383, against £64 last year, while the amount to be carried forward was very small indeed. The anticipation that the electrification of the lines and the linking-up of various sections would provide a considerable increase in passenger traffic had not been realised. There had been a falling-off of over £1,000 in traffic receipts. As there were signs of slight improvement in the iron and hardware industries in the Midlands, they might hope for better results next year. The chairman complained of the harrassing tactics of local authorities, which added to running expenses and everything else.

Mr. Lycett seconded.

Mr. Cecil Braithwaite said the company's position was a fair example of the position of the electrical industry in this country, consequent upon what he might call the "bullying" they were subjected to by local authorities. This had been done to the destruction of tramway companies all over the kingdom. Their company began by paying good dividends. He did not attribute the present position to bad management, but considered it a typical instance of how, as he firmly believed, the municipal people destroyed the property of other people.

Potteries Electric Traction Co., Ltd.—The report for 1908 states that the total receipts for the year amounted to £108,722. The traffic receipts showed a decrease of £3,223, due to the continued depression of trade in the district. After deducting all expenses chargeable to revenue, including £12,388 for debenture and other interest, there remains a balance of £21,339. The directors are placing to permanent way renewals account, £5,409; to depreciation and reserve fund, £1,000; general renewals account, £2,000; while there is paid in dividend at the rate of 5 per cent. per annum on the preference shares, £12,250, and carried forward £1,121. The depreciation and reserve account will then stand at £20,000, the debit balance on permanent way renewals suspense account will be entirely written off, and a balance of £2,000 will remain at the credit of the general renewals account. In view of the fact that considerable work still remains to be done on the permanent way and rolling stock, the directors recommend that the above increased provisions should be made and the financial position thus improved rather than that the surplus available should be distributed by way of dividends. Capital expenditure during the year amounted to £4,930.

Thames Ironworks Shipbuilding and Engineering Co.—The report of 1908 states that owing to the prevailing depression of trade and continued absence of Admiralty orders, the year's working has resulted in a net loss of £36,278; deducting £19,538 brought forward, there remains an adverse balance of £16,740, to cover which the directors recommend a transfer from the reserve of £20,000, leaving to carry forward £3,259.

Germany.—The Bergmann Elektricitäts-Werke Gesellschaft, of Berlin, is declaring a dividend of 18 per cent. for the last financial year.

MARKET QUOTATIONS.

Wednesday, May 12th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a ,, Nitric	,,	22/-	..
a ,, Oxalic	,,	28/-	..
a ,, Sulphuric	,,	5/6	..
a Ammoniac, Sal	,,	42/-	..
a Ammonia, Muriate (crystal)	per ton	£33 10	..
a ,, ,,	,,	£30	..
a Bleaching powder	,,	£5 10	..
a Bisulphide of Carbon	,,	£18	..
a Borax	,,	£16	..
a Copper Sulphate	,,	£20	..
a Lead, Nitrate	,,	£25 10	£2 inc.
a ,, White Sugar	,,	£23 10	..
a ,, Peroxide	,,	£32	..
a Methylated Spirit	per gal.	2/6	..
a Potassium, Bichromate, in casks	per lb.	3½d.	..
a Potash, Caustic (75/80 %)	per ton	£20	..
a ,, Chlorate	per lb.	3½d.	..
a ,, Perchlorate	,,	3⅞d.	¼d. dec.
a Potassium, Cyanide	,,	7d.	..
a Shellac	per cwt	77/-	..
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers	,,	£6 10	..
a ,, Recovered	,,	£5 10	..
a ,, Lump	,,	£5	..
a Soda, Caustic (white 70 %)	,,	£10 15	..
a ,, Chlorate	per lb.	3½d.	..
a ,, Crystals	per ton	£3 5	..
a Sodium Bichromate, casks	per lb.	3d.	..
a ,, Cyanide (basis 100 %)	,,	7d.	..
METALS, &c.			
b Aluminium Ingots, in ton lots	per ton	£70	..
b ,, Wire, in ton lots	,,	£112	..
b ,, Sheet, in ton lots	,,	£120	..
p Babbitt's metal ingots	,,	£50 to £135	..
c Brass (rolled metal 2" to 12" basis)	per lb.	7⅛d.	⅛d. inc.
c ,, Tube (brazed)	,,	8⅛d.	⅛d. inc.
c ,, ,, (solid drawn)	,,	7⅛d.	⅛d. inc.
c ,, Wire, basis	,,	6⅞d.	⅛d. inc.
c Copper Tubes (brazed)	,,	9⅛d.	⅛d. inc.
c ,, ,, (solid drawn	,,	9⅛d.	⅛d. inc.
g ,, Bars (best selected)	per ton	£78	£2 inc.
g ,, Sheet	,,	£73	£2 inc.
g ,, Rod	,,	£78	£2 inc.
e ,, (Electrolytic) Bars	,,	£61	£2 inc.
e ,, ,, Sheets	,,	£77 10	£2 inc.
e ,, ,, Rod	,,	£63 10	£2 inc.
e ,, ,, H.C. Wire	per lb.	8d.	1/32d. inc.
f Ebonite Rod	,,	3/8	..
f ,, Sheet	,,	8/-	..
n German Silver Wire	,,	1/6	..
h Gutta-percha, fine	,,	5/6 to 6/6	..
h India-rubber, Para fine	,,	5/4	⅛d. dec.
i Iron Pig (Cleveland warrants)	per ton	48/4	10d. inc.
i ,, Wire, galv. No. 8, P.O. qual.	,,	£14	..
g Lead, English Ingot	,,	£13 12 6 to £13 15	..
m Manganin Wire No. 28	per lb.	8/-	..
g Mercury	per bot.	£8 7 6	..
d Mica (in original cases) small	per lb.	6d. to 1s.	..
d ,, ,, ,, medium	,,	2/6 to 4/-	..
d ,, ,, ,, large	,,	4/6 to 8/6	..
p Phosphor Bronze, plain castings	,,	1/- to 1/1	..
p ,, ,, rolled bars & rods	,,	1/1½ to 1/8	..
p ,, ,, rolled strip & sheet	,,	1/2½ to 1/6	..
o Platinum	per oz.	100/-	variable.
e Silicium Bronze Wire	per lb.	..	..
r Steel Magnet, in bars	per ton	£55	..
g Tin, Block (English)	,,	£132 to £133	10s. dec.
g ,, Wire, Nos. 1 to 16	per lb.	1/8½	..
p White Anti-friction Metals:—			
"White Ant" brand	per ton	£35 to £60	..
k Zinc, Sh't (Vielle Montagne bnd.)	,,	£25	..

Quotations supplied by—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d F. Wiggins & Sons.
e Frederick Smith & Co.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd
g James & Shakspeare.
h Edward Till & Co.
i Bolling & Lowe.
k Morris Ashby, Ltd.
l Richard Johnson & Nephew, Ltd.
m W. T. Glover & Co., Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Co., Ltd.
r W. F. Dennis & Co.

Rangoon Electric Tramway and Supply Co., Ltd.—The report for 1908 states that the gross profits amount to £26,059. Liverpool office expenses required £2,473, interest on debenture stock, £6,750. After taking other items into account and including the amount brought forward, there is available £13,836. The preference dividend to December 31st, 1908, absorbed £12,278, and after writing off preliminary expenses £1,174, there is a balance carried forward of £383.

North of Scotland Electric Light and Power Co., Ltd.—The annual meeting was held at Montrose on Thursday last week. Bailie Stone, in moving the adoption of the annual report and balance-sheet, referred to the satisfactory progress the company had made in Montrose, Brechin and Inverness, and also pointed to the favourable prospects.

Doulton & Co., Ltd.—The accounts for 1908, after including £7,999 contributed by the chairman towards providing for the preference dividend, and writing £500 off goodwill, show (says the *Financial Times*) a credit balance at revenue account of £1,506.

STOCKS AND SHARES.

Tuesday Afternoon.

Stock Exchange trade flows rather erratically, and the volume of general business has become circumscribed in all but a few favoured directions. Kaffir shares, American rails and copper descriptions monopolise the greater part of the active interest, and investment departments are shadowed by a sagging away of Consols, due to the knowledge of impending heavy new issues by a multitude of borrowers. Of these, the London County Council is, for the time being only, the heaviest.

Revival of a very material nature has lifted Metropolitan District stocks within the last few days. For some time past the steady improvement in the company's traffics, as shown week by week in our tables, has aroused more general interest in the concern, and it needed but little buying to start a sharp rise in the various securities of the District. The stocks of the other companies intimately connected with the Underground Electric Railways of London have also hardened, Piccadilly 4 per cent. Debenture, for example, being raised to 94 buyers this week. In the better feeling for the District stocks, Metropolitans have also sympathised to a slight degree. It is of some interest to observe the progress made by quotations for Metropolitan and District stocks since the end of last year, and in the following table, the best-known issues are taken for purposes of comparison:—

Stock.	Dec. 31. 1908.	May 10. 1909.	Rise.	Last div.
Metropolitan Con.	87	89	2	½ % Jan.
do. 3½ % Pref.	87	89	2	3½ % Jan.
do. 3½ % Con. Pref.	75½	78	2½	3½ % Jan.
Metropolitan District Ordinary	14	17⅛	3⅛	1882.
do. 6 % Deb.	128½	140	16½	3 % Jan.
do. Exten. Pref.	25	44½	19½	1900.
do. Great Pref.	56½	69½	13	3½ % Jan.

Central London stocks are quiet after their substantial rises of a week ago, and the Deferred stock has slipped back a point. City and South London now stands 4 points higher than it did at the end of last year. Underground Electric Railway 6 per cent. Income bonds are 1 up at 36, and, as a gambling investment, present possibilities for better prices in the future.

Another movement is afoot for narrowing the ungainly prices in the Stock Exchange Official List so as to make them represent less unfaithfully the actual dealing quotations. The Stock Exchange Committee hailed a number of members before its august presence, and soundly rated them, in dignified language, for their folly in supplying prices so wide as to be misleading to the public, and so useful to certain of the advertising bucket-shops. One result of this action is to be seen in the numerous alterations made in our price-lists overleaf. While the quotations have been little altered actually, they certainly give a better idea of the market-price, and it is to be trusted that the tendency will be to narrow the margins still more—not to go back, as on previous occasions, to the bad old ways that ought to have been discarded years ago.

There are not many of such alterations to be found in the electricity supply section, which was in some measure "reformed" not long since, but which could do with a great deal more reformation of the same sort. Westminsters are easier, and so are St. James and Kensingtons. Urbans lost some of their latest firmness, but Edmundson's Debenture stock hardened to 61½. Notting Hill shares are 5s. up, City Ordinary 2s. 6d., River Plate Ordinary have improved, and Victoria Falls Preference remain at 17s. 6d.

Mexican Light and Power Common and Preference have recovered from their set-back, and Canadian and General capital stock fell 2½ to 121½, though the Preference at 120½ gained the amount of the fraction. Mexico Tramways have been less animated, and the price of the Common declined a point after its sharp spurt. Rio Trams went back to 104, while Sao Paulo at 157½ showed a rise of ½. Anglo-Argentine Trams are better, more especially the second Preference, which rose 7s. 6d.; the Debenture stock at 93½ has improved. British Columbia Electric Railway Preferred and Preference have advanced. Of the home varieties, there are no changes of significance in British Electric Tractions or London United Trams, but Potteries Ordinary are ⅛ lower. The Brush Company has issued a lugubrious report, which is not calculated to raise the depressed quotations for the company's issues.

Negative consolation may be gleaned by Brush shareholders from the fact that the Welsbach Incandescent had also had a very lean year in the period covered by the directors' report out this week. There is no dividend for the Ordinary shares, the price of which has fallen to about a florin, while the Preference are in the region of 11s.

The gamble in Anglo-American Telegraph Deferred stock still goes on, and the price has again been lifted. Yet the Preferred and the Ordinary are both somewhat lower. Western Telegraphs have hardened, and the advance in West India and Panama continues. The Eastern group is steady, and no change worth mentioning has occurred in the Trust companies' issues. National Telephone Preferred is better, and the Third Preference reacted after their rise.

In the manufacturing division, the weakness of British Aluminium Preferences is an outstanding feature. British Westinghouse Preference are back to about 7s. 6d. Babcock shares have lost part of their sharp advance of the previous week, the rise tempting sellers. Dick, Kerr Ordinary are better, and there is much excitement, with rising prices, in the rubber share market. Edison & Swan "A" shares and the 4 per cent. Debenture stock have fallen 2s. 6d. and 3 points respectively. British Insulated shares have improved.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. *	Dividends for the last four years. 1905.	1906.	1907.	1908.	Closing Quotations May 4th.	Closing Quotations May 11th.	Business done week ended May 11th, 1909. Highest	Lowest.	Rise + or Fall —	Present Yield per cent. £ s. d.
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	Nil	2⅞ — 3⅛	2⅞ — 3⅛	..	..	..	Nil.
136,700	Do. do. 5 % Debs., Nos. 1 to 1,360 Red.	100	5 %	5 %	5 %	5 %	92 — 95	93 — 95	..	..	+ ⅛	5 5 3
$131,551,400	American Telephone & Telegraph, Cap. Stock ..	$100	7⅞%	8 %	8 %	8 %	144 —145	144 —145	..	..	..	5 10 4
$58,000,000	Do. Collat. Trust, 4% Bonds, 1 to 28,000 and 53,001 to 78,000	$1000	4 %	4 %	4 %	4 %	98 –100	98 —100	..	..	..	4 0 0
598,180	Anglo-American Telegraph	Stock	3½%	3½%	3½%	£3 4s.	58 — 61	58 — 60	..	..	— ⅛	5 6 7
3,200,910	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	6 %	102 —104	101½ –102½	103	101½	+1	5 17 1
3,200,910	Do. do. do. Deferred	Stock	½%	1¾%	1 %	8/-	17⅜ — 17⅝	17⅛ — 18⅛	18⅛	16⅝	+ ⅛	1 6 3
50,000	Anglo-Portuguese Tel., 5 % Mort. Deb. Stock Red.	100	5 %	5 %	5 %	5 %	98 –100	98 —100	..	..	..	5 0 0
44,000	Chili Telephone, Nos. 1 to 44,000	5	8 %	8 %	8 %	..	8 — 8¼	8 — 8⅛	8⅛	8⅛	— ⅛	4 15 6
2,481,850	Commercial Cable Stlng. 500 year 4 % Deb. Sk. Red.	Stock	4 %	4 %	4 %	4 %	91 — 93	91 — 93	92	91½	..	4 6 0
16,000	Cuba Telegraph	10	5 %	5 %	6 %	6 %	8 — 9	8½ — 9	..	..	+ ⅛	6 13 4
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	10 %	17 — 18	17 — 18	..	..	..	5 11 1
12,981	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %	3 — 3⅛	3 — 3⅛	..	..	..	5 14 8
6,000	Do. do. 10 % Cum. Pref. ..	10	10 %	10 %	10 %	10 %	8½ — 9½	8½ — 9	..	..	..	5 11 1
30,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	100 –102	100 —102	..	..	..	8 16 6
60,710	Direct United States Cable	20	4½%	4½%	4½%	4½%	12½ — 13½	12½ — 13½	13⅛	12½	..	6 8 4
48,000	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200, R.	100	4½%	4½%	4½%	4½%	100 –102	100 —102	..	..	..	4 8 3
4,000,000	Eastern Telegraph, Ord. Stock..	Stock	7 %	7 %	7 %	7 %	134 –137	135 — 137	136½	135½	+ ½	5 2 2
2,000,000	Do. 8½ % Pref. Stock..	100	8½%	8½%	8½%	8½%	86 — 87	86 — 87⅛	87	86	+ ⅛	4 0 0
1,896,706	Do. 4 % Mort. Deb. Stock. Red. ..	Stock	4 %	4 %	4 %	4 %	102½–104¼xd	102½ –104½	102½	..	..	4 6 2
800,000	Eastern Extension, Australasia, and China Tele	10	7 %	7 %	7 %	7 %	12⅜ — 13	12⅜ — 12⅝	12⅝	12⅝	— ⅛	5 8 9
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	101 —103	101 —103	102	..	..	3 17 8
200,000‡	East & S. Afric. Tel., 4 % Mt. Db. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	.. — ..	101 —103	..	..	..	3 17 8
121,127	Globe Telegraph and Trust	10	5½%	5½%	5½%	..	10⅜ — 11⅛	10⅜ — 11⅛	11⅛	10⅜	+ ⅛	5 3 11
181,127	Do. do. 6 % Pref...	10	6 %	6 %	6 %	..	12⅛ — 13⅛	12⅛ — 13⅛	13⅛	13	+ ⅛	4 10 7
150,000	Great Northern Telegraph, of Copenhagen.. ..	10	24%	20 %	20 %	18%	27 — 29	26½ — 27½	27	..	—1	6 10 11
14,800‡	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,300, Red.	100	4½%	4½%	4½%	4½%	100 —102	100 —102	..	..	..	4 8 3
17,000	Indo-European Telegraph	25	13 %	13 %	13 %	13 %	51 — 54	52 — 54	53½	..	+ ½	5 18 2
$41,880,400	Mackay Companies Common	$100	2 %	3½%	4 %	4 %	78 — 82	78 — 82	..	..	..	4 17 7
$50,000,000	Do. do. 4% Cum. Pref.	$100	4 %	4 %	4 %	4 %	73 — 76	73 — 76	..	..	..	5 5 3
394,190	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	..	⅜ — ½	1⅛ — 1⅜	16/3	15/8	— ⅛	Nil
72,680	Monte Video Telephone Co., Ltd. Ord.	1	5 %	6 %	6 %	6 %	¾ — 1	¾ — 1	19/-	..	..	6 0 0
66,492	Do. do. 5 % Pref.	1	5	5	5	5	⅝ — ¾	⅝ — ¾	..	..	..	5 12 11
2,225,000	National Telephone, Pref. Stock	100	6	6	6	6	106 –108	107 —109	107⅞	107	+ ⅛	5 10 7
2,725,000	Do. do. Def. Stock	100	5	5	6	6	123 –125	123½ —124¾	124⅛	123	..	4 16 2
15,000	Do. do. 6 % Cum. 1st. Pref.	10	6	6	6	6	10½ — 11⅛	10½ — 11	10½	..	— ⅛	5 9 1
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6	5	6	6	10½ — 11⅛	10½ — 11	..	..	— ⅛	5 9 1
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5	5	5	5	5⅛ — 6	5⅛ — 5⅞	5⅛	..	— ⅛	4 5 1
2,000,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½%	3½%	3½%	3½%	98 100	98 —100	..	..	..	3 10 0
1,716,598	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	100 –102	100 —102	100⅜	100½	..	3 18 5
179,318	Oriental Telep. and Elec. 1 to 171,504, fully paid ..	1	7 %	7 %	8 %	8 %	1⅝ — 1⅞ xd	1⅝ — 1⅞	26/6	..	..	5 6 8
50,000	Do. do. do. 6 % Cum. Pref... ..	1	6 %	6 %	6 %	6 %	1⅛ — 1⅜ xd	1⅛ — 1⅜	23/6	..	..	5 1 1
99,100	Do. do. do. 4 % Red. Deb. Stock ..	100	4 %	4 %	4 %	4 %	88 — 90	88 — 90	..	..	..	4 8 11
99,400	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	10	4 %	4 %	4 %	4 %	100 –102	100 —102	..	..	..	3 18 5
11,889‡	Reuter's	8	5 %	5 %	5 %	5 %	7⅜ — 8⅛	7⅜ — 8⅛	..	..	..	4 16 1
99,100	Telephone Co. of Egypt, 4½ % Deb. Red.	100	4½%	4½%	4½%	4½%	100 –102	100 —102	..	..	..	4 8 3
3,083	Submarine Cables Trust	Cert.	6 %	6 %	6 %	6 %	127 –130	127 —130	..	..	..	4 12 4
120,000	United River Plate Telephone	5	8 %	8 %	8 %	..	6⅞ — 7⅛	6⅞ — 7⅛	7	6⅞	..	5 12 8
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	5 — 5⅛	5 — 5⅛	..	..	— ⅛	4 13 0
80,008	W. Coast of America, 1 to 80,000 & 58,001 to 58,008	2½	Nil	2½%	2½%	..	1⅛ — 1⅜	1⅛ — 1⅜	..	..	— ⅛	4 10 11
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	100 –102	100 —102	..	..	..	3 18 5
207,980	Western Telegraph, Ltd., Nos. 1 to 207,980.. ..	10	7 %	7 %	7 %	..	13½ — 13⅝	13½ — 13⅝	13⅝	13½	..	5 1 10
800,000	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	101 —103	101 —103	..	..	..	3 17 8
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	Nil	⅞ — 1	⅞ — 1	12/-	11/-	+ ⅛	Nil
84,568	Do. do. 6 % Cum. 1st Pref.	10	5 %	8 %	6 %	6 %	8½ 9	8½ — 9½	9⅛	..	+ ⅛	6 9 9
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	£2 6	15 %	8¼ — 9¼	8½ — 9½	..	..	+ ⅛	..
80,000‡	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	5 %	101 —103	101 —103	103	..	..	4 17 1

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

580,000	Anglo-Argentine Trams, 10 % Nom. Cum. 2nd Pref., 260,008 to 580,097	5	8 %	8 %	9 %	10 %	9⅛ — 9⅝	9⅞ — 9⅛	9⅞	9⅞	+ ⅛	5 8 8
260,007	Do. 6 % Cum. Prefs., 1 to 260,007 ..	5	5⅛%	5⅛%	5⅛%	6 %	6⅛ — 6⅜	6⅛ — 6⅜	6⅝	..	..	4 14 1
978,230	Do. 4 % Deb. Stock	..	..	..	..	..	92 — 94	92½ — 94⅛	93	..	+ ⅛	4 6 6
385,100	Auckland E. Trams, 5 % 1st Mort. Deb. Stock ..	100	5 %	5 %	5 %	5 %	102 —104	102 —104	104	103½	..	4 16 2
580,000	Babcock & Wilcox, 1 to 580,000	1	20 %	20 %	20 %	20 %	4⅞ — 4⅞	4⅛ — 4⅜	88/1½	86/10½	— ⅛	4 9 11
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	6 %	6 %	6 %	6 %	1⅜ — 1½	1⅜ — 1½	..	..	..	4 0 0
60,000	British Aluminium, Ord., 1 to 40,000	5	7 %	7 %	7 %	7 %	1 — 1⅛	⅞ — 1⅛	..	..	— ⅛	28 0 0
60,000	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	2⅜ — 2⅝	2 — 2⅜	..	..	— ⅛	14 0 0
40,100	Do. do. "A" 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	3½ — 4	3½ — 4	..	..	..	7 10 0
12,897	Do. do. 4 % Funding Certs.	5	4 %	4 %	4 %	4 %	3½ — 4⅛	3½ — 4⅛	..	..	..	4 8 11
124,400	Do. do. 5½ % Loch Leven Debs. ..	100	..	5½%	5½%	5½%	95 –100	95 —100	..	..	..	5 10 0
500,000	British Columbia E. Rail Def. Ord. Stock	100	6 %	6 %	8 %	8 %	140 –144 xd	140 —144	144½	143½	..	5 11 1
400,000	Do. Pref. Ord. Stock	100	5 %	5 %	5 %	6 %	122 –126	123 —127	126	122½	+1	4 14 6
800,000	Do. 5 % Cum. Perp. Pref. Stock	100	5 %	5 %	5 %	5 %	108½ –111½	109 —112	111	110½	+ ⅛	4 9 3
288,000	Do. 4½ % 1st Mort. Debs., 1 to 6,250	40	4½%	4½%	4½%	4½%	101 –103	101 —103	..	..	..	4 8 6
220,000	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	4½%	4½%	4½%	4½%	101 —104	101 —104	..	..	..	4 6 7
188,361	British Electric Traction	10	3 %	Nil	Nil	..	⅝ — ¾	⅝ — ¾	14/9	14/6	+ ⅛	Nil
161,487	Do. do. 6 % Cum. Pref.	10	6 %	6 %	3 %	..	2⅜ — 3⅛	2⅜ — 3⅛	60/7½	55/-	..	9 4 7
1,473,658	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	5 %	84 — 88	84 — 88	86	85½	..	5 13 8
528,986	Do. do. 4½ % 2nd Deb. Stock Red.	100	4½%	4½%	4½%	4½%	66 — 71	66 — 70	..	..	— ⅛	6 8 7
100,000	British Insulated and Helsby Cables	5	8 %	10 %	10 %	10 %	6⅞ — 7⅛	7⅛ — 7⅜	7⅜	7⅛	+ ⅛	6 13 4
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	6⅛ — 6⅜	6⅛ — 6⅜	..	..	..	4 10 1
500,000	Do. do. 4½ % 1st Mort. Deb. Red. ..	100	4½%	4½%	4½%	4½%	105 —108	105 —108	..	..	..	4 3 4
204,941	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	4½%	4½%	4½%	4½%	91 — 96	91 — 96	..	..	..	4 18 11
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	Nil	Nil	Nil	Nil	⅛ — ⅜	¼ — ½	..	..	— ⅛	Nil
1,016,868	Do. do. 4 % Mort. Deb. Stock ..	100	4 %	4 %	4 %	4 %	38 — 43	38 — 43	..	..	..	9 6 0
50,000	‡Browett, Lindley & Co., Ord.	1	Nil	Nil	Nil	..	⅜ — ⅝	⅜ — ⅝	..	..	..	Nil
50,000	‡ Do. do. 6 % Cum. Pref.	1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..	Nil
140,976	Brush Electrical Engineering, Ord., 1 to 105,731 ..	3	2½%	Nil	Nil	Nil	0 — ⅜	0 — ⅜	..	..	..	Nil
200,000	Do. do. Non-cum. 6 % Pref.	2	6 %	Nil	Nil	Nil	0 — ⅜	0 — ⅜	..	..	..	Nil
125,000‡	Do. do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	40 — 50	40 — 50	..	..	..	9 0 0
125,000‡	Do. do. 4½ % Perp. 2nd Deb. Stock..	Stock	4½%	4½%	4½%	4½%	29 — 33	29 — 33	..	..	..	13 12 8
197,610	Calcutta Trams, 1 to 197,610	5	8 %	8 %	8 %	..	4 — 4½	4⅛ — 4⅜	9⅝/-	8⅝/10½	+ ⅛	6 6 4
45,804	Do. 5 % Cum. Pref., Nos. 1 to 29,880..	5	5 %	5 %	5 %	5 %	4⅜ — 5⅛	4⅜ — 5⅛	..	..	..	4 15 3
250,000	Do. 4½ % 1st Deb. Stock..	100	4½%	4½%	4½%	4½%	99 –102	99 —102	..	..	..	4 8 3
35,000	Callender's Cable Construction shares	5	15 %	15 %	15 %	..	9⅛ — 10⅛	9⅛ — 10⅜	..	..	..	7 4 7
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	..	5⅛ — 5⅜	5⅛ — 5⅜	..	..	— ⅛	4 8 11
800,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	105 —107	105 —107	..	..	..	4 4
491,222	Cape E Trams., 1 to 491,222	1	Nil	Nil	Nil	..	⅜ — ½	⅜ — ½	..	..	..	Nil
450,000	Castner-Kellner Alkali, 1 to 450,000	1	6 %	8 %	12 %	..	1⅜ — 1⅝	1⅜ — 1⅝	36/6	36/3	..	6 8 0
210,153	Do. do. 4½ % 1st Mort. Deb. Stock	100	4½%	4½%	4½%	..	102 —106	102 —106	104⅜	..	..	4 4 11
1,898,610	Central London Railway, Ord. Stock..	Stock	4 %	4 %	3 %	3½%	69 — 71	69 — 71	70⅛	69½	..	4 11 7
553,195	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	4 %	85 — 87	85 — 87	..	..	..	4 12 0
553,195	Do. do. Def. do.	Stock	4 %	4 %	2 %	2½%	53 — 55	52 — 54	54⅛	53⅛	..	4 12 7
1,480,000	City and South London Railway	Stock	1⅞%	2½%	3½%	1¾%	30¼ — 31½	30¼ — 31½	30⅞	30⅛	..	4 15 8
85,000	Crompton & Co., Nos. 1 to 85,000	1	2½%	5 %	5 %	5 %	1 — 1⅛	1 — 1⅛	22/3	..	..	9 7 6
100,000‡	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	5 %	95 — 98	95 — 98	..	..	..	5 2 6

* Unless otherwise stated, all shares are fully paid † A period of nine months. ‡ From Manchester Share List

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—(*Continued*)

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years. 1906.	1906.	1907.	1908.	Closing Quotations May 4th.	Closing Quotations May. 11th.	Business done week ended May 11th, 1909 Highest	Lowest.	Rise + or Fall —	Present Yield per cent. £ s. d.
260,000	Dick, Kerr & Co., 1 to 260,000	1	10 %	10 %	10 %	10 %	1 7/16 — 1 1/2	1 1/2 — 1 5/16	..	..	+ 1/16	7 12 5
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	1	6 %	6 %	6 %	6 %	1 31/32 — 2	1 15/16 — 1 31/32	..	..	..	4 16 0
276,880	Do. do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	101 —104	101 —104	..	..	..	4 6 7
60,000	Dublin United Trams. (1896), 6 % Pref., 1 to 60,000	10	6 %	6 %	6 %	6 %	12¾ — 13¼	12¼ — 13½	..	..	..	4 8 11
99,261	Edison & Swan Utd., "A" shs., £3 pd., 1 to 99,261	5	4½%	4½%	4½%	..	3/8 — 7/16	3/8 — 7/16	..	..	— 1/16	25 0 0
17,189	Do. "A" shares, 01—017,189	5	4½%	4½%	4½%	..	1¼ — 2¼	1¼ — 2¼	..	..	..	8 6 9
317,875	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	75 — 78	70 — 75	..	..	— 4	5 6 8
67,720	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	..	84 — 87	84 — 87	..	..	..	5 12 4
112,100	Electric Construction, 1 to 112,100	2	Nil	Nil	Nil	Nil	1/4 — 3/8	1/4 — 3/8	..	..	..	Nil
31,890	Do. do. 7 % Cum. Pref., 1 to 31,890	2	7 %	7 %	7 %	7 %	1 — 1¼	1 — 1¼	..	..	..	11 4 0
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	..	7¼ — 7⅝	7⅜ — 7¾	..	..	+ 1/16	6 9 0
200,000	Do. do. 4 % Mort Deb.	Stock	4 %	4 %	4 %	4 %	81 — 83	85 — 88	..	..	+ 3	4 10 11
78,000	Gt. N. & City Rail. Pref. Ord. "A" 4 %, 1 to 78,000	10	4 %	4 %	4 %	Nil	3/8 — 1/2	3/8 — 1/2	..	..	..	8 0 0
96,000	Greenwood & Batley, 7 % Cum. Pref.	10	7 %	7 %	7 %	..	10¼ — 10⅜	10¼ — 10⅜	..	..	..	6 10 8
80,000	Do. do. 5 % Mort. Debs.	100	5 %	5 %	5 %	5 %	102 —103½	102 —103	..	..	..	4 16 10
40,000	Henley's (W. T.), Telegraph Works, Ord.	5	15%	15 %	15%	15 %	11⅞ — 12⅛	11⅝ — 12⅜	12⅛	..	..	6 1 2
40,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	4½%	5⅛ — 5⅜	4⅞ — 5⅛	..	..	— 1/16	4 1 10
150,000	Do. do. 4½ % Mort. Deb. Stock	Stock	4½%	4½%	4½%	4½%	108 —108	106 —108	..	..	..	4 5 9
60,000	India-Rubber, Gutta-percha & Telegraph Works	10	10%	10 %	10 %	..	14½ — 15½	14½ — 15½	15 5/16	15	..	6 5 0
87,500	Liverpool Overhead Railway, Ord.	10	Nil	Nil	½%	Nil	1/16 — 1	1/16 — 1	..	..	..	Nil
10,000	Do. do. Pref., fully paid	10	5 %	5 %	5 %	5 %	5 — 6	5 — 6	..	..	..	8 6 8
600,070	London United Trams. (1901), 1 to 50,007	10	3 %	3 %	3 %	Nil	2 — 3	2 — 3	..	..	..	4 8 11
999,980	Do. do. 50,008 to 100,000	10	3 %	3 %	3 %	Nil	3½ — 4	3½ — 4	..	..	..	4 8 11
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	5 %	5 %	5 %	3½%	3 — 4	3 — 4	66/3	65/-	..	9 7 6
1,881,000	Do. do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	70 — 75	71 — 75	73	..	+ 1	5 6 8
5,732,062	Metropolitan Consolidated	100	2⅜%	2⅜%	2⅜%	2⅜%	36½ — 37½	38⅜ — 39½	39½	38 7/16	+2	1 5 5
2,640,914	Do. Surplus Lands	100	2⅜%	2⅜%	2⅜%	2⅜%	69 — 71	69 — 71	69⅜	69	..	3 17 6
3,285,000	Do. District	100	Nil	Nil	Nil	Nil	15 — 15½	17⅛ — 18	18	15½	+2½	Nil
291,337	Metropolitan Electric Trams., Ord.	1	..	..	..	4½%	3/8 — 1/2	3/8 — 1/2	13/6	13/1½	..	..
314,016	Do. do. Defd.	1	Nil	Nil	Nil	Nil	3/32 — 5/32	3/32 — 5/32	1/-	..	..	Nil
500,000	Do. do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	3/32 — 5/32	3/32 — 5/32	16/3	15/6	..	5 19 5
600,000	Do. do. 4½ % Deb. Stock Red.	100	4½%	4½%	4½%	4½%	95¼ — 97½	95⅝ — 97½	97	96	..	4 12 4
$6,000,000	Mexico Trams Co., Common Stock	..	..	..	..	..	147 —149	145 —148	149	146½	+1	..
$9,000,000	Do. 1st Mort. 50-year 5% Gld. Bds.	..	..	..	..	5 %	96 — 97	96 — 97	97½	96½	..	5 3 1
245,500	Potteries Electric Traction	1	4 %	4 %	4 %	Nil	1/8 — 3/16	1/8 — 3/16	..	..	— 1/16	8 13 0
245,500	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	3/16 — 1/4	3/16 — 1/4	..	..	..	6 17 11
245,000	Do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	89 — 91	88 — 91	..	..	..	4 18 11
87,350	Telegraph Construction and Maintenance	12	15 %	15 %	17½%	15 %	32 — 34	32 — 33½	33⅜	32⅜	— ½	7 4 6
150,000	Do. 4 % Deb. Bds., 1 to 1,500 Red., 1909	100	4 %	4 %	4 %	4 %	101 —103	101 —103	..	..	..	3 17 8
1,000,000	Underground Electric Railway, 5% Prior Lien	..	..	..	..	..	101½—102½ xd	101 —102	102½	..	— ½	..
2,800,000	Do. do. 4½% Bonds	..	..	..	..	4½%	86 — 88	86 — 88	87⅛	87	..	5 2 3
4,200,000	Do. do. 6% Income Bonds	..	..	..	..	..	34 — 36	35 — 37	36	..	+1	..
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	1	Nil	Nil	10 %	Nil	3/8 — 7/16	3/8 — 7/16	15/-	..	..	..
66,666	Do. 6 % C.P., 30,001 to 80,000 & 125,001 to 141,666	5	Nil	..	6 %	6 %	2⅞ — 3⅛	2⅞ — 3⅛	..	..	..	7 14 10
246,404	Do. % 1st Mort. Deb. Stock		4 %	4 %	4 %	4 %	78 — 82	78 — 82	..	..	..	4 17 7

ELECTRICITY SUPPLY COMPANIES.

15,000	Bromley (Kent) E.L. & P., 1 to 15,000		5½%	5⅝%	5⅝%	5½%	4¼ — 4⅜	4¼ — 4⅜	..	..	..	5 10 0
70,000	Do. do. 4½ % 1st. deb. stock	100	4½%	4½%	4½%	4½%	93 — 96	93 — 96	..	..	..	4 13 9
80,275	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 80,000	5	10 %	10%	10 %	10 %	8½ — 9	8⅝ — 9	..	..	..	5 11 1
9,725	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	8 — 8½	8 — 8½	..	..	..	4 2 4
856,876	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	99 —102	99 — 102	..	..	..	3 18 5
80,000	Charing Cross and Strand Electricity Supply	5	5 %	5 %	5 %	5 %	3¾ — 4¼	3¾ — 4¼	..	..	..	5 17 8
80,000	Do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	4½%	4¼ — 4⅜	4¼ — 4⅜	77/6	..	..	4 17 4
80,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	4½%	3¾ — 4¼	3¾ — 4¼	..	..	..	5 5 11
445,786	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	98 —101	98 —101	..	..	..	3 19 3
42,486	Chelsea Electricity Supply, Ord.	5	6 %	4½%	4½%	4½%	3⅝ — 4⅛	3⅝ — 4⅛	77/6	..	..	5 9 1
175,000	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	102 —105	102 —106	..	..	..	4 5 9
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	6 %	6 %	6 %	6 %	10⅜ — 10⅝	10⅜ — 11	10⅝	..	+ 1/8	5 9 1
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	11⅜ — 12½	11⅜ — 12½	12 1/16	..	..	4 16 0
400,000	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	5 %	121 —123	121 —123	..	..	..	4 1 4
800,000	Do. 4½ % 2nd. Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	4½%	101 —104	101 —104	..	..	..	4 6 7
50,000	County of Durham Electrical Power, Ord.	5	4 %	4 %	2 %	..	2⅜ — 3½	2⅜ — 3½	..	..	..	3 6 8
50,000	Do. do. do. 5 % Pref.	5	5 %	5 %	5 %	5 %	3½ — 3¾	3½ — 3¾	..	..	..	6 13 4
250,000	Do. do. do. 5 % 1st Mtg. Deb.	Stock	..	..	..	5 %	96 — 98	96 — 98	..	..	..	5 2 0
40,000	County of London Electric Lighting, Ord. 1—40,000	10	5 %	5 %	5 %	5 %	8⅜ — 8⅝	8⅜ — 8⅝	8½	..	..	5 14 3
59,997	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	10⅜ — 11⅛	10⅜ — 11⅛	10⅝	..	— 1	5 6 8
400,000	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	4½%	106 —109	105 —108	..	..	— 1	4 3 4
400,000	Do. do. 4½ % 2nd. Deb. Stock	Stock	4½%	4½%	4½%	4½%	99 —102 xd	99 —102	101	..	..	4 6 7
80,000	Edmundson's Electric Corporation, Ord. Shares	5	4 %	Nil	Nil	Nil	1/16 — 1/8	1/16 — 1/8	..	..	..	Nil
80,000	Do. do. 6 % Cum. Pref.	5	6 %	3 %	Nil	Nil	3/16 — 1/4	3/16 — 1/4	17/-	14/-	..	Nil
480,500	Do. do. 4½ % 1st Mort. Deb. Stk.	100	4½%	4½%	4½%	4½%	59 — 62	60 — 63	62	..	+1	7 2 10
$8,150,000	Electrical Dev.Co.of Ontario, 5% 1st Mtg. Gold Bnds.	$500	..	..	..	5 %	88 — 90	88 — 90	89	88½	..	5 11 1
10,000	Folkestone, 1 to 10,000	5	5½%	5½%	5½%	5½%	4¾ — 5	4¾ — 5	..	..	..	5 10 0
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	5 %	5 %	5 %	5 %	5 — 5⅛	5 — 5⅛	..	..	..	4 10 0
90,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	96 — 99	97 —100	..	..	+1	4 10 11
15,000	Hove, 1 to 15,000	5	9 %	9 %	8½%	8½%	7⅜ — 7⅝	7⅜ — 7⅝	..	..	..	5 9 8
$2,400,000	Kaministiquia Power Co., 5 % Gold Bnds.	..	..	..	..	5 %	99 —101	99 —101	100⅛	99⅛	..	5 4 11
21,000	Kensington and Knightsbridge Electric Ord.	5	10 %	10 %	10 %	8 %	7⅜ — 7⅝	7⅜ — 7⅝	7½	..	— 1/16	6 1 8
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	93 — 96	94 — 97	..	..	+1	4 2 6
111,000	London Electric Supply Corporation, Limited, Ord.	3	4 %	4 %	2½%	3 %	1⅝ — 2⅛	1⅝ — 2⅛	..	..	..	4 16 0
70,000	Do. do. do 6 % Pref.	5	6 %	6 %	6 %	6 %	5 — 5⅜	5 — 5⅜	..	..	..	5 11 8
374,895	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4½%	4½%	4 %	92 — 96	92 — 96	95	94½	..	4 3 4
200,000	Metropolitan Electric Supply, 1 to 100,000	5	10 %	8 %	8½%	5 %	4⅜ — 5	4⅜ — 5	95/-	..	— 1/16	5 0 0
76,121	Do. 4½ % Cum. Pref. 1—71,106	5	4½%	4½%	4½%	4½%	4⅜ — 5⅛	4⅜ — 5⅛	..	..	— 1/16	4 5 9
220,000	Do. 4½ % 1st Mort. Deben. Stock	..	4½%	4½%	4½%	4½%	107 —110	107 —110	..	..	..	4 1 10
248,000	Do. 3½ % Mort. Deben. Stock Redem.	Stock	3½%	3½%	3½%	3½%	85 — 88	85 — 88	..	..	..	3 19 7
$6,000,000	Mexican Electric Light Co., 5% 1st Mtg. Gold Bnds	..	5 %	5 %	5 %	5 %	88½ — 89½	89½ — 89½	89½	88¾	..	5 11 9
13,585,000	Do. Light and Power Co., Ltd., Common	$100	..	..	..	3½%	76 — 78	77 — 79	78	77½	+1	4 9 9
$1,500,000	Do. do. 7% Cum. Pref. Stk.	Stock	..	..	..	7 %	109 —111	111 —113	111½	110½	+2	6 6 2
$12,000,000	Do. do. 5% 1st Mtg. Gold Bnds.	..	..	..	..	5 %	92 — 93	92 — 93	93	92	..	5 7 6
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	95 — 98	95 — 98	95⅝	..	..	4 11 10
87,500	Newcastle-on-Tyne, 1 to 87,500	5	8 %	8 %	8 %	2½%	4⅜ — 5⅛	4⅜ — 5	..	..	— 1/16	2 10 0
87,500	Do. 5 % Pref., 1 to 87,500	5	5 %	5 %	5 %	5 %	4⅜ — 5⅛	4⅜ — 5⅛	..	..	..	4 15 3
126,500	North Metropolitan Electric Power Supply Co., 5 % Mortgages (Red.), Nos. 1 to 1,265	100	..	..	..	..	99 — 101	99 —101	..	..	..	..
10,859	Notting Hill Electric Lighting	10	7½%	7½%	7½%	7 %	11 — 12	11½ — 12½	..	..	+ ½	5 14 3
20,000	Oxford, 1 to 96 and 407 to 20,310	5	7 %	7 %	7 %	..	6 — 6½	6 — 6¾	..	..	..	5 7 8
50,000	Do. 4 % Deb. Stock	100	4 %	4 %	4 %	4 %	94 — 97	94 — 97	..	..	..	4 1 8
119,694	River Plate Elcty. Co. Ord. Nos. 1 to 120,507	1	..	2½%	6 %	8 %	1½ — 1⅝	1⅝ — 1¾	28/6	..	+ ⅛	5 6 8
100,000	Do. do. 6% Non Cum. Pref. Nos. 1 to 100,000	1	6 %	6 %	6 %	6 %	1 — 1⅛	1 — 1⅛	21/8	..	..	5 6 8
194,684	Do. do. 5% Deb. Stk. Red.	100	5 %	5 %	5 %	5 %	102 —106	102 —106	..	..	..	4 14 4
40,000	St. James' and Pall Mall Electric Light, Ord.	5	12½%	10 %	10 %	10 %	9 — 9½	8⅞ — 9⅜	..	..	— ⅛	6 15 7
70,000	Do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	7 %	7 — 7½	7 — 7⅜	..	..	..	4 18 4
150,000	Do. do. 3½ % Deb. Stock Red.	100	3 %	3½%	3½%	3½%	86 — 90	86 — 90	..	..	..	3 17 9
12,000	Smithfield Markets Electric Supply, Ord.	5	4 %	Nil	Nil	Nil	3/8 — 7/16	3/8 — 7/16	..	..	..	Nil
85,000	South London Electric Supply, Ord.	4	4 %	3 %	4 %	5 %	2⅜ — 2⅝	2⅜ — 3⅛	57/6	..	..	6 9 0
30,000	South Met. Elec. Lt. & Power, Ord.	1	2½%	2½%	2½%	2½%	5/16 — 3/8	5/16 — 3/8	..	..	..	4 8 11
149,968	Do. do. 7 % Pref.	1	7 %	7 %	7 %	7 %	1⅜ — 1⅝	1⅜ — 1⅝	..	..	..	5 9 10
220,000	Do. do. 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	100 —103	100 —103	..	..	..	4 0 0
80,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	5 %	¾ — 1	⅞ — 1	13/9	..	— 1/16	25 0 0
50,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	2 — 2½	2 — 2½	44/4½	40/-	..	10 0 0
275,000	Do. do. 4½ % 1st Mort. Db. Stk. Red.	100	4½%	4½%	4½%	4½%	80 — 84	80 — 84	82½	..	..	5 7 2
606,000	Victoria Falls Power Co., Pref. Nos. 1 to 800,000	1	..	..	..	5 %	1⅛ — 1⅜	1⅛ — 1⅜	17/6	..	..	..
110,000	Westminster Electric Supply, Ord.	5	12 %	12 %	10 %	10 %	9⅛ — 9⅜	9⅛ — 9⅜	9½	..	— ⅛	6 11 2
81,979	Do. do. 4½ % Cum. Pref. Reduced from 5% since 31st Dec., 1905)	5	5 %	4½%	4½%	4½%	5⅛ — 5⅜	5⅛ — 5⅜	..	..	+ ⅛	4 0 0

* Unless otherwise stated, all shares are fully paid. † Quotations on Liverpool Stock Exchange. Interim Dividend.

Bank rate of Discount 2½ per cent., April 1st, 1909.

THE RATING AND COST OF STEAM ELECTRIC GENERATING STATIONS.

By H. M. HOBART, M.Inst.C.E.

(*Continued from page* 782.)

We are now in a position to re-arrange our tables, taking as the characteristic basis of ratings, the annual output in megakelvins and the load factor. From Tables I and IV we deduce Table IX, which gives the total cost of electricity supply stations for various outputs and load factors. In Table X this cost data is reduced to the total cost in £ per megakelvin of annual output.

TABLE IX.

Rated output of station in megakelvins per year.	Total costs of electricity supply stations in £ for following load factors—						
	1·00	0·80	0·60	0·40	0·30	0·20	0·10
1·00	8,350	9,170	10,400	12,500	13,850	22,500	37,500
2·00	13,360	15,040	17,200	22,600	25,000	37,300	62,200
5·00	25,150	27,800	33,700	46,750	54,250	74,500	120,000
10·0	39,000	45,000	59,300	80,700	97,500	130,000	212,000
20·0	66,800	74,400	95,200	136,000	175,000	220,000	384,000
50·0	130,000	161,500	205,000	285,000	360,000	490,000	917,000
100	245,000	293,000	364,000	505,000	636,000	...	...
200	440,000	530,000	660,000	...	...	...	...
300	636,000	753,000	...	...	...	...	...

TABLE X.

Rated output of station in megakelvins per year.	Total costs of electricity supply stations in £ per megakelvin of annual output for following load factors—						
	1·00	0·80	0·60	0·40	0·30	0·20	0·10
1·00	8,350	9,170	10,400	12,500	13,850	22,500	37,500
2·00	6,680	7,520	8,600	11,100	12,500	18,650	31,100
5·00	5,030	5,560	6,740	9,200	10,850	14,900	24,000
10·0	3,900	4,500	5,930	7,800	9,750	13,000	21,200
20·0	3,340	3,720	4,760	6,500	8,750	11,000	19,200
50·0	2,600	3,230	4,100	5,500	7,200	9,800	18,340
100	2,450	2,930	3,640	4,950	6,360	...	...
200	2,200	2,650	3,350	...	...	...	...
300	2,120	2,530	...	...	...	...	...

TABLE XI.

Rated output of station in megakelvins per year.	Annual capital expenses in £ per megakelvin for following load factors—						
	1·00	0·80	0·60	0·40	0·30	0·20	0·10
1·00	835	917	1,040	1,250	1,385	2,250	3,750
2·00	668	752	860	1,130	1,250	1,865	3,110
5·00	503	556	674	935	1,085	1,490	2,400
10·0	390	450	593	807	975	1,300	2,120
20·0	334	372	476	680	875	1,100	1,920
50·0	260	323	410	570	720	980	1,834
100	245	293	364	505	636	...	...
200	220	265	335	...	...	...	...
300	212	253	...	...	...	...	...

TABLE XII.

Rated output of stations in megakelvins per year.	Annual capital expenses in pence per kelvin output for following load factors—						
	1·00	0·80	0·60	0·40	0·30	0·20	0·10
1·00	0·200	0·220	0·250	0·300	0·333	0·540	0·900
2·00	0·161	0·181	0·206	0·271	0·300	0·448	0·746
5·00	0·121	0·134	0·162	0·224	0·261	0·358	0·576
10·0	0·095	0·108	0·142	0·194	0·234	0·312	0·509
20·0	0·080	0·089	0·114	0·163	0·210	0·264	0·461
50·0	0·063	0·078	0·099	0·137	0·173	0·235	0·440
100	0·059	0·070	0·087	0·121	0·153	...	...
200	0·053	0·064	0·080	...	...	...	...
300	0·051	0·061	...	...	...	...	...

The values in Table XI are, in each case, 10 per cent. of the corresponding values in Table X; the 10 per cent. covering the interest and maintenance expenses.

The equivalent values in pence per kelvin are given in Table XII.

Table XIII has been deduced from Table V, and indicates the rated capacity of generating sets which should be installed in any case :—

TABLE XIII.

Rated output of station in megakelvins per year.	Aggregate rated capacity in kw. of generating sets installed, for following load factors—						
	1·00	0·80	0·60	0·40	0·30	0·20	0·10
1·00	187	217	276	407	528	760	1,460
2·00	369	421	535	792	1,030	1,500	2,850
5·00	890	1,030	1,320	1,900	2,470	3,610	6,950
10·0	1,700	2,015	2,570	3,750	4,870	7,050	13,600
20·0	3,270	3,920	5,070	7,500	9,790	13,900	26,200
50·0	7,810	9,490	12,660	18,500	23,200	33,600	64,800
100	15,400	18,800	24,400	34,000	45,200	...	...
200	30,600	36,700	47,500	...	...	...	...
300	45,200	55,000	...	...	...	...	...

Table XIV gives the corresponding data reduced to terms of the rated capacity required to be installed, per megakelvin of annual output :—

TABLE XIV.

Rated output of station in megakelvins per year.	Rated capacity in kw. of all generating sets installed per million kelvins delivered from the generating station per annum for following load factors—						
	1·00	0·80	0·60	0·40	0·30	0·20	0·10
1·00	187	217	276	407	528	760	1,460
2·00	185	211	268	396	515	750	1,425
5·00	178	206	264	380	494	722	1,390
10·0	170	201	257	375	487	705	1,360
20·0	164	196	254	375	489	695	1,310
50·0	156	189	253	370	464	672	1,296
100	154	188	244	340	452	...	...
200	153	184	238	...	...	...	...
300	151	183	...	...	...	...	...

Of the total installed capacities given in Table XIII for various cases, the percentages shown in Table XV must be considered as spare plant, leaving available for immediate service the rated capacities set forth in Table XVI.

TABLE XV.

Rated output of station in megakelvins per year.	Percentage to be regarded as spare plant for following load factors—						
	1·00	0·80	0·60	0·40	0·30	0·20	0·10
1·00	39	34	31	30	28	25	22
2·00	38	32	29	28	26	24	20
5·00	36	31	28	25	23	21	18
10·0	33	29	26	24	22	19	16
20·0	30	27	25	24	20	18	13
50·0	27	25	24	23	18	15	12
100	26	24	22	19	16	...	...
200	25	22	20	...	...	...	...
300	24	22	...	...	...	...	...

TABLE XVI.

Rated output of station in megakelvins per year.	Capacity available for immediate service for following load factors—						
	1·00	0·80	0·60	0·40	0·30	0·20	0·10
1·00	114	143	190	285	380	570	1,140
2·00	228	286	380	570	760	1,140	2,280
5·00	570	712	950	1,425	1,900	2,850	5,700
10·0	1,140	1,430	1,900	2,850	3,800	5,700	11,400
20·0	2,280	2,860	3,800	5,700	7,600	11,400	22,800
50·0	5,700	7,120	9,500	14,250	19,000	28,500	57,000
100	11,400	14,300	19,000	28,500	38,000	...	...
200	22,800	28,600	38,000	...	...	...	...
300	34,300	42,900	...	...	...	...	...

The use of these tables reduces the design of electricity supply stations to a much more rational process than that heretofore customary.

The methods which are employed do not take into sufficiently prominent account the *purpose* of the electricity supply station, and give undue prominence to the characteristics and component capacities of the machinery employed in accomplishing the purpose. When a railway company builds a new locomotive shop, it first estimates the number of locomotives which will be required per year, and then provides such buildings and tools as shall suffice for this output. It does not express the capacity of the works in terms of the capacity of the engine or engines employed for driving the line shafting. The *input* to the locomotive works is coal and steel and various other materials. The *output* is *locomotives*. The *input* to the electricity works is chiefly *coal* and the *output* is *electricity*. In the former case we require a certain number of locomotives per year; in the latter case a certain quantity of electricity. In both cases the works should be rated in terms of their *outputs*, the rating of the machinery employed in obtaining these outputs being regarded as a matter of detail, which, while of the utmost importance, nevertheless does not justify the prominence of serving to indicate the capacity of the works. Thus, in Table XIII, have been given data sufficient to determine the aggregate rated capacity of the generating sets which should be installed in electricity works of given capacities in megakelvins per annum and for given load factors. But it is the *output*, and not these aggregate capacities, which should serve as designation for such electricity works.

From this point of our investigation onward it is the values that have been set forth in Table XII, which will best serve our further purposes so far as relates to the annual capital expenses, which we may, for brevity, term the capital cost per kelvin. This constitutes but one component of the total cost per kelvin, and we may designate it Component I.

It will be convenient to reduce the further costs going to make up the total cost per kelvin, to only two components, which we shall designate Component II and Component III. The three components may be classified as follows:—

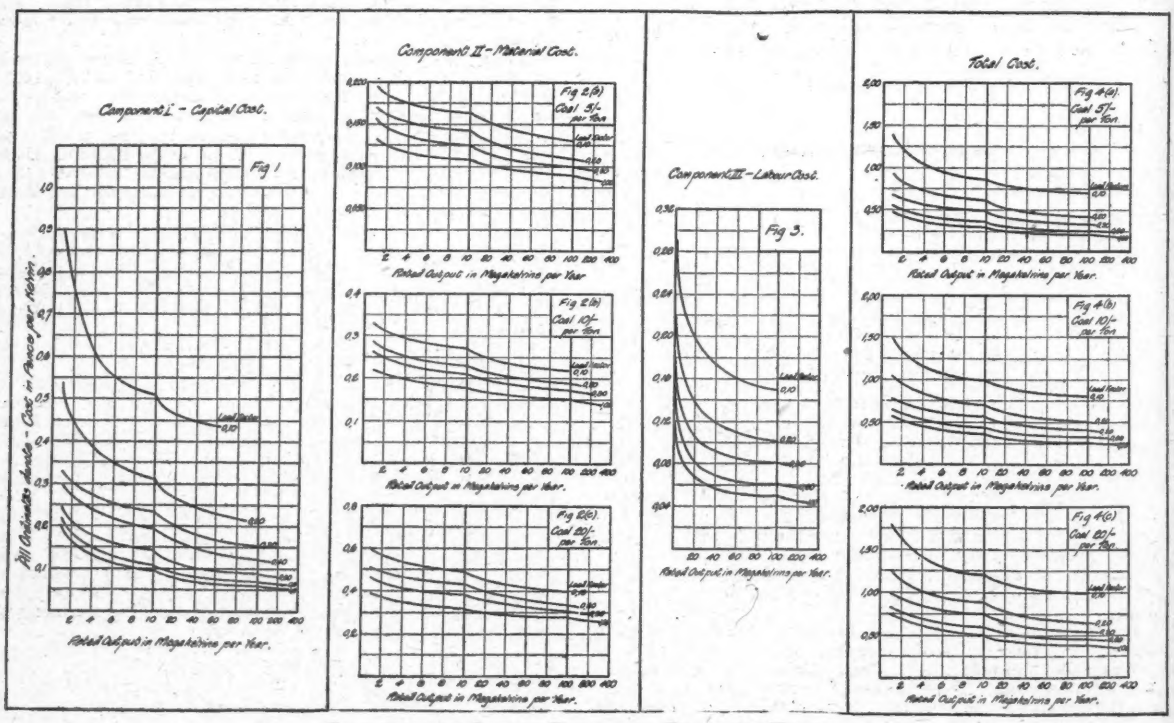
Component I.—Outlay for repairs, upkeep and renewals, and the outlay in interest on capital. Each year such outlays for repair, upkeep and renewals should be incurred as suffice to leave the plant at the end of the year in just as valuable a condition as at the beginning of that year.

Component II.—Outlay for coal, water, oil and stores.

Component III.—(*a*) Salaries and wages of all persons required to run the undertaking as an electricity manufacturing establishment; and (*b*) rates, taxes, insurance, penalties, &c. From (*a*) are to be excluded all salaries and wages paid in securing, or endeavouring to secure, a market for the product manufactured (*i.e.*, for the electricity). In other words, the undertaking stops at the outgoing cables.

We have already investigated Component I, and have arrived at the values given in Table XII. These have been plotted in the curves in fig. 1 below. While the data are not universally appropriate, it may be said that it would—in the present state of the development of engineering, and at the present market prices for machinery, labour and capital—be practically impossible to reduce these values by 30 per cent. Any considerable reduction in the outlay for machinery will entail an increase in the annual expenses for maintenance, and will also tend to increase the material and labour expenses, *i.e.*, Components II and III. On the other hand, many, even amongst modern undertakings, are costing 50 per cent. and more in excess of the data in fig. 1.

It is more difficult to generalise with regard to Component II, since this is very dependent upon the prices paid for coal and water, and these vary widely in different localities and at different times. With coal of good quality (say, 8,700 kelvins per ton) at a price, delivered at the electricity works, of 10s. per ton, and with no abnormal charges for water, reasonable values for Component II may be obtained from the curves in fig. 2*b*. Where fuel is exceptionally low in price (corresponding, say, to good coal at 5s. per ton, as may often be the case for stations situated in coal districts or at the pit head) the values may be taken from fig. 2*a*. For cases where fuel is high in price (say, 20s. per ton for good coal), the values may be taken from fig. 2*c*. For simplicity, we shall assume coal of good quality—say, 8,700 kelvins per ton—for all cases. Where coal is of less good quality, corresponding modifications must be made.



COMPONENTS OF COST OF GENERATION, PENCE PER KELVIN.

The general method by which the values in figs. 2*a*, 2*b* and 2*c* have been derived may be illustrated by taking as an example the case of a station designed to deliver, at a load factor of 0·3, 100 megakelvins per annum. The reasonably attainable overall efficiency of such a station is 9 per cent. Thus the input is—

$$\frac{100{,}000{,}000}{0{\cdot}09} = 1{,}110{,}000{,}000 \text{ kelvins.}$$

If the coal is of a calorific value of 8,750 kelvins

per ton, then $\frac{1.110,000,000}{8,750}$ = 127,000 tons of coal will be required during one year. At 10s. per ton (fig. 2*b*) this will cost £64,000. Thus the fuel cost is—

$\frac{64,000 \times 240}{100,000,000}$ = 0·154d. per kelvin of output from the station. From fig. 2*b* we find the total cost of materials given as 0·17d. per kelvin. The additional 10 per cent. should, with representative conditions as regards the required quantities of circulating water and of oil, &c., be sufficient. In striving to reduce the coal cost, a point will be reached where the increasing quantities of circulating water, and the capital outlay for increased capacity of cooling towers and condensing plant, will more than outweigh the saving in coal. Generally, however, a 10 per cent. addition to the fuel cost should suffice to cover the remaining material costs.

The other points from which the curves of figs. 2*a*, 2*b* and 2*c* have been plotted, have been similarly obtained.

Component III is so much smaller than components I and II, that any inexactness in it exerts comparatively little influence on estimates of the total cost. Values for component III may be taken from the curves in fig. 3.

The total cost in pence per kelvin is given in figs. 4*a*, 4*b* and 4*c* for low, medium and high-priced coal.

(*To be concluded.*)

PROCEEDINGS OF INSTITUTIONS.

Electrical Installations on Steamships.

By H. T. Boothroyd.

(*Abstract of paper read before the* Liverpool Engineering Society, *March 31st*, 1909.)

In this country it is usually considered good practice to wire all machinery spaces, holds, &c., with lead-covered cable having a spiral steel armouring; the accommodation, with lead-covered wires clipped to deck or bulkhead; and saloons, with ordinary vulcanised wiring concealed behind panelling.

Other methods are to use wood casing throughout; or, as on the Continent, to use steel tubing for mains and light brass tubing for small wires in the accommodation; or to run mains in steel tubing through holds or along decks (in the case of oil boats), and wire machinery spaces in screwed steel conduit, and the accommodation with either lead-covered surface wiring or vulcanised wire in wood casing.

In considering the best system to adopt, the question of single wire and ship return or double wire crops up.

Where the voltage does not exceed 110, the single wire appears most suitable, except for oil carriers. The objection as to derangement of compasses does not appear to the author to be a serious one in view of the number of liners fitted on this system, including the White Star and Donald Currie fleets; the British India Co. also has a combination of both systems, the lights being double wired to distribution boards and the mains single wired with ship return.

The author describes a typical passenger steamer installation, of the single-wire distribution type, at 110 volts, and fitted with 600 lights and a complete equipment of motor-driven machinery, fans, &c.

There are two 30-kw. dynamos, supplying eight main circuits, terminating on sub-switchboards fitted with a s.p. quick-break switch and fuse on each sub-circuit.

The whole of the wiring is 2,500 meg. lead-covered, armoured cable, braided over armouring in the machinery space, holds, &c., and where clipped to iron decks or partitions; the braiding prevents bulging of the armouring at bends, and when painted is impervious to salt water. In the accommodation, lead-covered wire is clipped to the surface; the saloon, music, smoke rooms, &c., are double wired back to distribution boxes, to avoid earth connections in inaccessible places; the wire to each lamp is arranged so that it can be used to draw in a new wire if required. Short circuits in saloons, &c., are generally due to deck leakage, which corrodes the wires where they enter fittings; at such points the wires should be painted with good insulating paint.

No soldered joints are permitted, and mains and wires are in single lengths; any joints are made with joint boxes, with terminals mounted in porcelain, &c.

Glands are fitted where cables pass through water-tight bulkheads, and fibre or lead bushes where they pass through beams; galvanised deck tubes, 2 ft. high, filled with bitumen, protect cables passing through decks. The masthead light wires are run up the mast in galvanised steel tubing.

Deck fittings, which usually give trouble, have glass fronts fixed with cement-putty, and are made water-tight with rubber gaskets; the wires are also led in through a bitumen sealed pipe. Cargo sockets are fitted in heavy cast-iron water-tight boxes fixed in 'tween decks; the connectors are of heavy fibre faced with brass, in the form of a fork. This type of connector stands rough usage better than the plug and socket type, and is not so easily removed by light-fingered individuals.

The wiring to the accommodation is arranged for about five lights to one fuse on distribution boards, to avoid soldered joints. Looping-in boxes are provided with porcelain bases and cast-iron covers.

All the wires and cables are practically in sight and accessible, and any short-circuit would immediately reveal itself.

The system of wiring in grooved wood casing is fast dying out; it is unsightly, troublesome to repair, and liable to damage by short-circuits or water.

Steel tubing must be screwed, with inspection boxes at all bends and water-tight fittings; in machinery spaces tubes have been corroded through in a very few years. The British Admiralty practice of wiring is excellent but costly; and twin wiring has nothing to recommend it except cheapness.

On the subject of driving auxiliaries, the author pleads for the liberal adoption of motor-driven centrifugals in place of steam-driven reciprocating pumps, refers to the use of motor-driven barring gear and ash hoists, and records the successful electrical steering gear of the ss. *Faraday*.

The principal objection to electrically-driven capstans is that the motor could not be run slowly and be brought to a standstill when the strain becomes too great, in the same way as can be done by a steam engine. The author suggests that the introduction of an adjustable friction clutch would overcome the difficulty; and that the motor need not be of excessive size owing to its intermittent working.

The author then refers to certain features of the installation of the *Mauretania* (Electrical Review, April 3rd to 17th, 1908), and goes on to discuss the question of motor-driven winches, to which, he suggests, the primary objection is first cost. On the score of reliability he instances the electrically-driven pile-drivers, worked by navvies, which have been in use at the Hull Joint Dock, out in the open. These are fixed on gantries in the river and in the bottom of the dock; the motors work at 500 volts, and are in every way satisfactory.

In the case of ship's electric winches, he suggests that the ordinary centre barrel could be omitted, and the shaft, &c., be made strong enough to allow of either (warping) end drum being used with a fixed or loose fall, the gear being heavy enough to take full load and speed regulation of the motor replacing the ordinary double gear. Electric winches are fitted on the cross-channel steamers of the G.W. Railway Co., in which the drums are driven by machine-cut worm-gearing working in oil.

As a possible case, he instances a vessel equipped with 12 12-b.h.p. winches, nine pumps, steering gear, ash hoist, windlass, turning engines, &c., and 600 lights, or 356 kw. of plant, which could be operated by three 75-kw. generating sets, one being spare.

The author briefly refers to night signalling, electric sounding, heating and telephone apparatus, concluding with some remarks on electric propulsion.

The night signalling apparatus, adopted by the Admiralty and many lines, consists of a lantern fitted with 16 5 or 6-c.p. high-efficiency lamps arranged in two circular rows one above the other and fixed on the masthead; this is operated from the bridge by Morse keys, a condenser being fitted in circuit. Many patent shutter lanterns are on the market, but they cannot be operated with anything like the speed of the Morse key.

Faraday Society.

A varied programme, touching both practical and theoretical interests, was discussed at the last meeting of the Faraday Society, held on April 27th.

The Finlay Electrolytic Alkali-Chlorine Cell.

The latest practical type of electrolytic alkali cell formed the subject of the first paper, which was contributed by Prof. F. G. Donnan, Dr. J. T. Barker and Mr. B. P. Hill, who have made extensive laboratory tests on the cell under question. Unlike the well-known Castner-Kellner cell, but like the Hargreaves-Bird and Townsend cells, the Finlay cell is of the "diaphragm" type, in which the products of electrolysis of the salt solution, sodium (redissolving to caustic soda) and chlorine, are kept from re-combination by means of porous diaphragms. The Finlay cell, however, is a double diaphragm cell, and contains, therefore, three separate chambers, namely, anode and cathode compartments separated by a middle line chamber, as shown diagrammatically in the accompanying figure (fig. 1, p. 824); this illustrates the laboratory unit used by the authors, in which the anode compartment is central, there being two middle compartments and two outer cathode compartments. The anodes are made of slats of Acheson graphite, the cathodes of wrought-iron sheets.

An important feature of the cell is the circulation of the electrolyte, the purpose of which is to prevent any mixing of the anode and cathode liquids—due to diffusion or electric endosmose—and to reduce by the counter-flow of electrolyte the migration flow of OH^1-ions from the cathode to the anode compartments. The OH^1-ions tend to disintegrate the carbon anodes, and their presence in the anode chamber is the chief cause for loss of current efficiency in cells of this kind, and hence the arrangement here adopted considerably increases the efficiency of the cell. The circulation is effected by having a head of liquid over the middle brine com-

partment. A glance at the diagrammatic fig. 2 will make clear the general circulation system of the cell. The liquid in tank H keeps up the head in middle compartment G, and causes the salt solution to flow in opposite directions through the two diaphragms to the

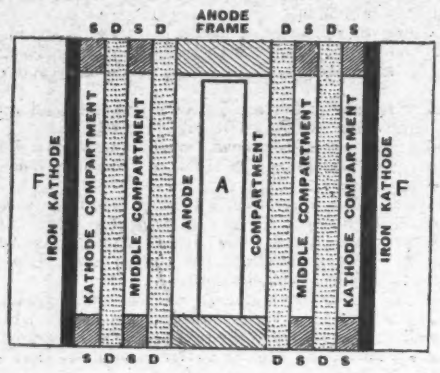


FIG. 1.

anode and cathode compartments A and B. Chlorine and hydrogen respectively escape at C and D, whilst chlorinated brine flows away at E and A mixture of caustic soda and brine at F—the rate of flow of each being obviously adjustable.

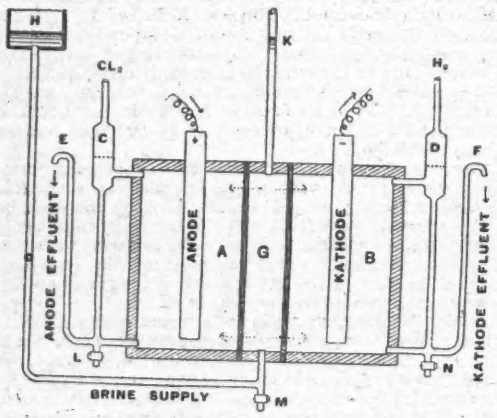


FIG. 2.

A commercial cell is built up from the single cell indicated in fig. 1 by bolting together any number of compartments, constructed by placing between the diaphragms thin rectangular frames of waxed cardboard, 2 or 3 mm. thick. The bolting-up is effected by means

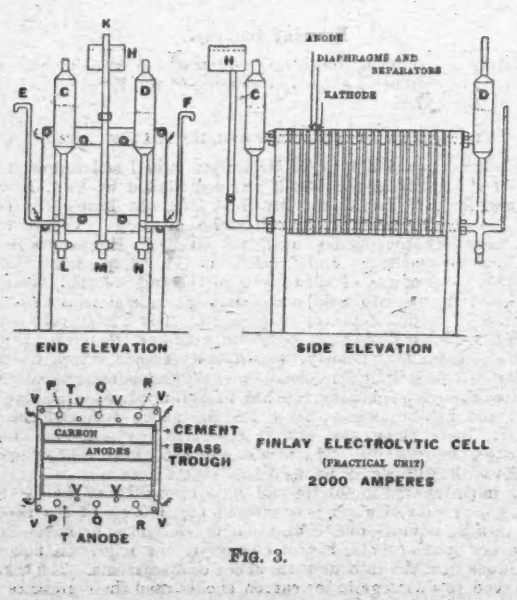


FIG. 3.

of an arrangement of overlapping holes and slots in the upper and lower (electrolytically inactive) portions of the diaphragms, separators, anode frames and cathodes. By the juxtaposition of these holes continuous ducts are formed running right through the cell for feeding the electrolyte and carrying away gases and liquors. The complete arrangement is shown in fig. 3, from which it will be noticed that the complete unit is not dissimilar in structure to an ordinary filter press, and that the various layers of electrolyte being simply thin sheets of liquid, the resistance of the cell is reduced to an extremely low figure. A 2,000-ampere unit, such as is shown in fig. 3, measures only 4 ft. long by 2 ft. 6 in. broad by 4 ft. high. The laboratory cell tested by Prof. Donnan was of smaller dimensions than this, carrying only 10 to 20 amperes. The diaphragms in this cell consisted of the asbestos diaphragm sold for electrolytic purposes by Beinfeld, of Leipzic, but we are not told what diaphragms are used in the industrial cell—a reticence that will, unfortunately, not surprise the student of electrochemical processes, for any choking of the diaphragms must be the chief source of trouble in a cell whose efficacy depends on the freedom with which the electrolyte can circulate.

The following table of figures will give an idea of the results obtained in the authors' tests:—

Brine (density = 1·18). Temperature, 17°-19° C. Current density = 0·0217 amp./sq. cm. Average voltage = 3·37.

Gm. NaOH per 100 gm. cathode liquor.	Per cent. current efficiency.	Per cent. energy efficiency.	Gm. NaOH per KW.-hour.
4	98·0	66·9	434
5	96·5	65·9	428
6	94·5	64·5	419
7	93·0	63·5	412
8	91·0	62·1	403
9	89·0	60·7	394
10	87·5	59·7	388
11	86·5	59·0	383
12	83·5	57·0	370
13	81·5	55·6	361

As regards anodic efficiencies, it was found that when making 7 per cent. caustic, the anode gases contained 98·4 per cent. chlorine, and when making 13·6 per cent. caustic, 94 per cent. chlorine. Mr. Robert Finlay, however, who took part in the discussion, stated that far better results than those given above had since been obtained with a commercial unit, solutions containing 8 gm. caustic soda per 100 cm.³ having been made at a voltage of 3 (from brine at ordinary temperatures), with a current efficiency of 98 per cent. If these results can be obtained after lengthy continuous running, they certainly constitute a very great advance over anything that has—as far as one knows, for published data are conspicuously scanty—been up to the present obtained with diaphragm cells, and the Finlay cell should do something considerable towards hastening forward the day when all but electrochemical methods of manufacturing alkali are of historic interest only.

It is gratifying to note that these interesting tests have been made in the new Muspratt Electrochemical Laboratory of the Liverpool University, which, under the able direction of Prof. Donnan, is thus proving its determination to keep in touch with the technical as well as the theoretical side of electrochemistry.

The Electromotive Force of Certain Platinum Compounds, with Special Reference to the Oxygen-Hydrogen Gas Cell.

This was the title of a carefully worked-out paper by Dr. Percy E. Spielmann. In it he attempted to explain the known variations of the Grove gas cell (in which platinum foils, saturated with hydrogen and oxygen gases respectively, form the electrodes) by supposing there to be actual chemical reaction between the oxygen and the platinum foil used as electrode, rather than by secondary reactions within the electrolyte.

His conclusions, based on elaborate E.M.F. measurements of the various hydrated platinum oxides and other salts, point definitely to the existence of direct oxidation of the platinum electrodes, although the border line of physical and chemical action is here so closely touched upon, that many will hesitate to distinguish between oxidation, physical occlusion and solid solutions, and perhaps will even profanely suggest that different people are calling the same phenomena by different names. The uncertainty of the evidence caused by disturbing influences bound to be present in E.M.F. measurements of electrodes, such as here considered, does not seem to us to warrant the assertion that *definite* hydrated oxides of platinum are formed, although that some sort of oxidation of platinum takes place seems undoubted. It has previously been observed—by Tafel, Senter, and Haber, among others—that a platinum anode will go into dilute acid solution under certain conditions.

Electric Smelting.

By F. W. Harbord, Assoc.R.S.Mines, F.I.C.

(*Abstract of paper read before the* West of Scotland Iron and Steel Institute.)

Electric furnaces may be broadly divided into three classes—(1) Induction furnaces; (2) Resistance furnaces; and (3) Arc furnaces; and the selection of any particular type of furnace will be decided largely by the particular work it is required to do.

So far as the metallurgy of iron and steel is concerned, the operations may be divided into two classes, viz., actual reduction

processes which involve smelting in the true metallurgical sense, and refining and smelting, which generally simply involve the melting together of suitable mixtures, with or without oxidising agents to produce definite results. Although the induction furnace can be used for the direct reduction of ores of various metals, it is more particularly adapted for the manufacture of steel. For the manufacture of alloys some form of resistance or arc furnace is generally employed.

The induction furnace is a large crucible in which the steel is melted by an induced current out of contact with any electrodes, completely protected from the action of any furnace gases, and practically protected from oxidation. It gives, from a metallurgical point of view, by far the nearest approach to the conditions of the crucible process, and provided the same care is taken in the selection of the raw materials, a finished product, equal in all respects to crucible steel, is obtained. The best known furnace of this type is the Kjellin furnace, which has been in operation at Gysinge, Sweden, since 1900. This furnace is in effect a step-down transformer, in which the contents of the hearth or crucible form the secondary circuit of the transformer.

Any grade of steel can be produced in this furnace from 0·10 to 1·50 per cent. or more of carbon, the only thing necessary being to have ample power to ensure rapid melting, and to obtain a sufficiently high temperature to enable the steel to be cast into ingot moulds.

During the melting there is practically no elimination of impurities, with the exception of a slight oxidation of the carbon, and to obtain a high-class product, high-class materials must be used.

The amount of energy consumed will vary with the grade of steel desired, a high carbon steel requiring less than a low carbon steel, as the former has a lower melting point, and does not require to be raised to such a high final temperature to enable it to be cast into ingot moulds without "skulling." The average time for working a charge is five to six hours for high carbon steel and from seven to eight hours for dead soft, or nearly carbonless steel. Some of the latest furnaces are mounted on tilting frames for convenience of teeming into the ladle.

Various modifications of the Kjellin induction furnace have been introduced during the last few years, amongst others the Frich and the Hiorth furnaces, but there is no new principle involved in either of these, and they vary only in detail from the original furnace at Gysinge, although both inventors claim considerable practical advantages for their furnaces.

One great disadvantage of the Kjellin type of furnace from a practical point of view is the narrow ring channel forming the hearth of the furnace, and this is especially so for furnaces of comparatively large capacity. This form of furnace offers difficulties in charging, repairing, &c., if refining is to be done by extremely basic infusible slags. It is difficult, if not impossible, to maintain these slags sufficiently hot, and consequently fluid, to do the necessary work, as the induced currents prefer the path of least resistance, namely, that of the metallic bath. Further, the power factor of these induction furnaces is always low, and although this may be improved by reducing the frequency of the alternating current, it has been found that such an unusually low frequency would be required for large furnaces that very expensive generators would be necessary. These various disadvantages, both metallurgical and electrical, have been largely overcome by the designers of the Roechling-Rodenhauser furnace, which may be regarded as a combination of an induction and resistance furnace.

Like the Kjellin induction furnace, this furnace is essentially a transformer with a single primary winding around both iron cores of the transformer. The secondaries are two in number. One is the molten bath in form of a figure 8, the channel between the two cores being very broad; the other secondary is a copper winding, which is connected with metal plates inserted into the furnace walls in such a way that the currents pass from the winding through the plates, and through a mass of highly refractory electrolytic conductors (of the same nature as the filaments in the Nernst lamp) to the molten mass. In this way the molten mass is subjected to a double heating effect, one direct by induction and the other from the currents passing between the opposite sets of electrodes.

The whole furnace is built as a tilting furnace.

The latest development in connection with this furnace is its operation by a three-phase instead of a single-phase current, which enables a 15-ton furnace to be operated with a frequency of 50 periods instead of 25, and standard three-phase generators to be used. It is claimed that a special feature of this furnace is the rotation of the charge due to the presence of a rotating field, as in an induction motor, which ensures an automatic circulation in the bath. The furnace is basic lined, and is being used almost exclusively for refining molten steel made in the Bessemer or open-hearth process, although, provided it were started with a small quantity of molten metal, there is no reason why cold scrap and pig should not be charged.

In the resistance furnace the heat is generated by the resistance offered by the whole, or a portion, of the furnace charge to a very powerful electric current. It is represented by the Héroult and Keller, Ginod, Giffre and Gin furnaces, all of which are employed commercially in the manufacture of steel and alloys of iron.

The Héroult furnace for the manufacture of steel has been in successful operation for some years, and a number of furnaces are now producing steel commercially. The furnace hearth is basic lined, as in the ordinary basic open-hearth process, and two large electrodes pass vertically through the roof, and can be raised or lowered either by hand or automatically by a specially constructed regulator. An alternating current of 4,000 amperes and 110 volts is used at the Héroult works at La Praz, and the intensity of the current passing through the bath is regulated by increasing or decreasing the width of the air-gap between the electrodes and the slag line.

One very great advantage connected with this furnace is that common steel scrap of good average quality, such as bar ends, rail ends, &c., can be converted into steel of the highest quality, and it is not necessary to use an exceptionally pure or high-priced material, as in the induction furnace. The construction of the furnace is such that it enables the impurities in the scrap iron to be readily removed by the addition of suitable fluxes, and the slag can be poured off, and a new slag made at will to further remove any remaining impurities.

With cold scrap the working of the charge takes from five to six hours according to the grade of steel required, but it is in the refining of ordinary molten steel, made either in an ordinary Bessemer converter or open-hearth furnace, that the Héroult furnace promises to give the best results in the future. The cost of this refining is extremely small, the amount of energy required not exceeding 250 to 300 KW.-hours per ton of steel, and the produce obtained is of the highest quality.

In the arc type of furnace the necessary heat is obtained by direct radiation from the arc and by reflection from the roof and sides of the furnace. The Stassano furnace is the best known furnace of this type for either the smelting of iron and production of pig-iron or steel direct from the ore, or for the manufacture of steel from steel scrap, or mixture of pig-iron and scrap, iron ore being added in the usual way to oxidise the impurities, and lime to form a basic slag. The furnace rotates round an axis inclined about 7° to the vertical, but this is not essential, as a fixed furnace can be used. Either two or three electrodes may be used, and in the latter case a three-phase alternating current is employed and distributed between the three electrodes. At the Stassano works at Turin there are furnaces varying in size from 100 to 1,000 E.H.P. One of the earlier furnaces, producing from 4 to 5 tons of steel per day from pig and scrap, had a current of 4,900 amperes at 150 volts, distributed to four electrodes forming two arcs with 2,450 amperes each. At the new Stassano steel works, energy is supplied by the Societa Alta Italia from public supply mains in the form of three-phase currents at 21,500 volts. The pressure is reduced in the works by transformers to 80 volts for the 100-H.P. furnace (single-phase), 100 volts for the 200-H.P. furnace, and 150 volts for 1,000-H.P. furnace (three phase).

The electrodes are cylindrical in shape, about 6 in. in diameter, from 50 to 60 in. long, and weigh about 132 lb. The furnace is lined with magnesite blocks made specially to the shape of the furnace; even under unfavourable conditions these blocks are stated to last 40 days with slight repairs to the parts in contact with the slag.

The furnaces at Turin are principally employed for the manufacture of steel castings of extremely soft quality, although large quantities of projectiles for the Italian Government are also made from pig and scrap.

One special point claimed by Stassano is that not only is he able to make steel from pig and scrap, but by using very pure ores and carefully adjusting the proportions of carbon and fluxes, he is able to make *steel of any required grade* direct from the ore.

The ores used are the very purest hematites, and these, after most careful analysis, are ground very fine, and mixed with just sufficient fluxes to form a fusible slag, and with sufficient carbon to effect the reduction, and are then moulded into briquettes. The arc takes no part in the reduction, but simply supplies the heat, the reduction being effected entirely by the solid carbon. As there is no combustion of the carbon by oxygen, the reduction cannot be effected by carbonic oxide, but by the carbon; and hence it is necessary to have all the materials of the charge finely ground and briquetted, so that the oxides and carbon may be in very intimate contact. The rotation of the furnace also assists in maintaining this contact after the bath is molten. By very carefully adjusting the amount of carbon so that it is present in a quantity just sufficient to reduce the oxide, extremely soft pure iron practically free from carbon is obtained, which is stated to give exceptionally good results for dynamo purposes.

This furnace is also being used for refining steel from Bessemer or other processes. The results obtained both as regards costs and quality of product are said to be most satisfactory.

The simplest form of resistance furnace for direct reduction of iron ores and manufacture of alloys is the ordinary carbide resistance furnace, which consists simply of a vat-shaped furnace with a carbon block built into the sole of the furnace and a vertical electrode suspended above the top of the furnace by suitable gear, by which it can be easily raised or lowered into the furnace; the ore, mixed with the necessary amount of reducing agent and suitable fluxes, is fed into the furnace from the top between the electrode and walls of the furnace.

It is extremely difficult to compare the cost of production in the different furnaces, as to obtain reliable results, it would be necessary to carry out an exhaustive series of experiments with each furnace, working under identical conditions as to supply of raw materials, &c., but so far as the consumption of energy is concerned for the production of the same grade of steel, there is probably no very great difference.

In starting with cold materials, such as steel scrap and pig, the consumption of energy per ton of steel produced may be taken at from 750 to 1,000 KW.-hours, according to grade of steel produced and the size of the furnace, as in larger furnaces the energy consumed per ton of steel is less. The cost of refractories will vary considerably with the size of the furnace and the price of the materials delivered at the works, but probably a fair figure is 3s. to 3s. 6d. per ton under ordinary conditions, although in steel-making districts in England this might be somewhat less. The consumption of electrode will also vary somewhat with the type and size of

the furnaces, in the Héroult furnace about 35 lb. being used per ton of steel produced, and in the Girod about the same, whereas in the Stassano arc furnace only about 20 to 22 lb. per ton of steel is stated to be consumed.

Under British conditions, however, there seems little probability of any form of electric furnace being used with cold materials, except in the comparatively few cases where it is employed for melting Swedish scrap for the production of high-class tool steel, and it is as a refiner for ordinary Bessemer or open hearth steel that the electric furnace is likely to be of interest to British steel manufacturers.

The cost of refining, of course, varies with the degree to which it is carried, and with the size of furnace, &c., but the consumption of energy for the complete refining of ordinary Bessemer metal is stated not to exceed 300 KW.-hours per ton of steel, and for many purposes 120 to 150 KW.-hours is said to be sufficient. Taking electric energy at ½d. per unit for complete refining, after making reasonable allowances for repairs, wages, &c., the costs should be under £1 1s. per ton, and for many purposes an expenditure of this kind would be fully justified to obtain an exceptionally pure material; 8-ton furnaces working on these lines are refining from 100 to 130 tons of steel in the 24 hours, when producing what may be termed second quality electric steel, and from 50 to 60 tons, when producing high grade steel of exceptional purity. One Roechling-Rodenhauser furnace has been making rail steel in Germany for rails subjected to exceptionally hard wear.

From the British standpoint, the direct smelting of iron ores in the electric furnace is of little practical importance, as, although considerable advances have been and are being made, the conditions existing in our country are such that the electric furnace cannot compete with the blast furnace. In countries which have no suitable fuel for blast-furnace work, but have large ore deposits and cheap water-power, such as Canada, many of the South American Republics, and countries similarly situated, the position of direct smelting is different, and the gradual developments are being watched with the greatest interest.

So far as the metallurgy of iron smelting is concerned, the position is fairly clear, but what is required is a furnace which is capable of continuous working and dealing with fairly large quantities of material. The future developments of direct smelting practically depend upon the electrical engineer, and it is for him to design a furnace which, from a mechanical and electrical point of view, is efficient. That the problem is worth the serious attention of electricians is shown by the great number of inquiries one receives from all parts of the world, and the author knows a number of people who would at once consider the question of putting down small smelting plants in districts where blast furnaces are impossible, provided he could assure them that a suitable furnace had been designed which was giving good commercial results. A large output is not necessary, and in many cases a furnace producing 100 tons per week would suit the local requirements and conditions in out-of-the-way countries better than the large production of a modern blast furnace.

A process which is being experimented with at Niagara on a commercial scale with considerable promise of success, is the Lash process for direct production of steel from the magnetic iron and other sands. At the experimental plant a 1,000-H.P. furnace of the Héroult type is used. About 67 per cent. of finely ground magnetic iron ore is very carefully mixed with 23 per cent. of cast-iron borings in granulated pig-iron, and 10 per cent. to 15 per cent. of coke dust and about 4 per cent. of slaked lime, and either briquetted in an ordinary briquette machine or charged as it is in sufficient quantity to make about 4 tons of steel. About 100 lb. of steel scrap is placed on the top of this charge, and a small bar put into the furnace to form an arc for the electrodes; these latter are then lowered into position, the current turned on, and the furnace closed up tightly until the electric charge is melted. When completely melted the slag is removed by pouring, and a new finishing slag made, and the refining finished in the usual way. The results of the experiments gave an average of about 1,400 KW.-hours per ton of steel, and the only serious trouble was the consumption of electrodes; so far experiments have been tried only in the Héroult furnace, and if an induction furnace of the Roechling-Rodenhauser type were used, this difficulty would disappear.

A large number of alloys are now being produced in the electric furnace and used in our steel works.

The author is of opinion that steel, equal in all respects to the best Sheffield crucible steel, can be produced in any good type of electric furnace at considerably less cost; that steel of the very highest quality, exceptionally low in phosphorus and sulphur, and distinctly superior to ordinary open-hearth metal, can be produced by refining either Bessemer or open-hearth steel at a very small cost in this country; and that, by carrying the process of refining still further, at a very small additional cost steel equal to crucible steel can be obtained.

Further, under favourable conditions as to cost of raw materials, especially if a surplus of blast furnace gas is available for generating electrical energy, ferro-silicon and similar alloys can be produced at a cost to compare favourably with imported material produced from water power. With regard to pig-iron, this can be produced of any grade and of satisfactory quality, but the electric furnace cannot compete commercially with the blast furnace under the conditions existing in this and other countries, where fuel is cheap.

Discussion.

Dr. Desch said that, for the manufacture of alloys, particularly those low in carbon, the electric furnace seemed ideal. Mr. Harbord had shown that the impurities in steel could be brought down more than in the ordinary process, for one could get a purer slag even when highly basic, but that implied very cheap power, and would make it expensive where power had to be generated by the use of coal.

Mr. Campbell, speaking of the productive cost per ton, pointed out that in the United States, the Steel Corporation had put down 215 ton electric furnaces, and the cost would be about 5s. per ton if the price of the electricity was ½d. per unit. In large factories he considered they could generate their own power at even less than ½d. per unit, and in such cases it would be profitable to put in electric furnaces where good steel was required. It was not essential that steel equal to crucible steel should be obtained for the electric furnace to be successful. In Germany much of the crucible process had been abandoned and the electric furnace installed. The speaker proceeded to refer to experiments carried on in California, where there was no coal within reasonable distance and coke had to be brought from afar, and said that in places like that there was no doubt that electric smelting of iron might be feasible. There was no doubt that the next few years would see electric smelting adopted in England for special purposes.

In reply, Mr. Harbord, said he thought that for refining, provided they had molten metal and transferred it to any good type of electric furnace, in three hours, at an expenditure of energy equal to 3 KW. per ton, they could produce a material equal to Swedish steel. If they took ordinary metal made from miscellaneous hematite iron and spent £1 upon refining it, they would get a material equal to Swedish. He estimated that they could refine 50 tons a-day in eight heats a-day at 3 KW. a ton. The electrical furnace had passed into the commercial stage not only as a refiner but as a method of making steel castings. In one works he knew of, they had put in two electric steel furnaces. In that case they were paying not quite ½d. per unit for their energy. The consumption of energy for 80 per cent. of ferro-silicon was about 75 H.P. per ton used. One small furnace of the iron-cased, brick-lined variety could be built for £200 complete. He advocated the electric furnace as nothing more than an adjunct in this country at present. It was only possible to make steel electrically where blast furnaces were impossible; but he suggested that steel makers should investigate its possibility as a refiner in making a high class of steel.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Drake & Gorham Switchboards.

Messrs. Drake & Gorham have recently put upon the market an enamelled slate board similar to the illustration below, which they intend for the purpose of meeting the large demand for a reliable

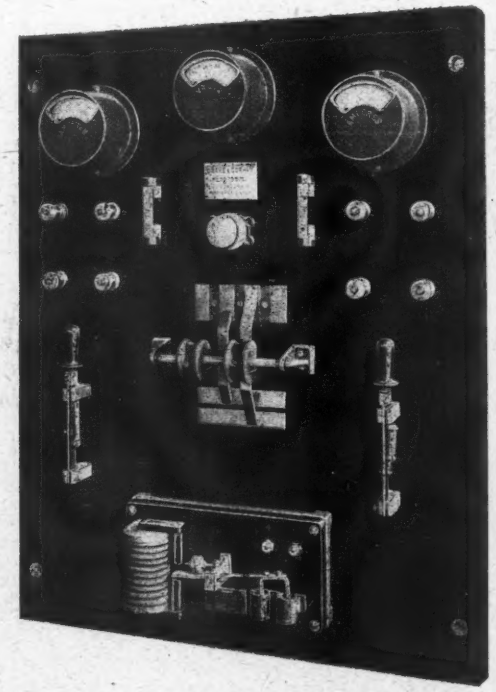


Fig. 1.—Lighting and Battery Switchboard.

switchboard for 25 and 50-volt installations at a low price. This is fitted with two 4-in. black and nickel ammeters, one voltmeter, two single-pole knife switches with double-pole fuses, one double-pole voltmeter plug with two single-pole fuses, one Nevile automatic cut-in and cut-out, and one of their registered "Fool-proof"

battery regulators, which renders it impossible to reverse the regulating cells whilst running the plant when lights are in use. These boards are very compact, the over-all size being 2 ft. × 2 ft. 6 in., and as the switches are made to fall right over when in the "off" position, the greatest projection from the front of the slate is only 3 in. We understand that owing to the number of orders that have been received for these boards, it has been found necessary to stock 25-ampere and 50-ampere sizes at their works at 3, Felix Street, Westminster Bridge Road, where they are manufactured, and that delivery can be given the same day as orders are received.

A New Gear Wheel.

Messrs. Smith, Barker & Willson have protected and are producing a gear wheel, of which the main body is a steel casting in one piece, intended to remain permanently on the axle to which

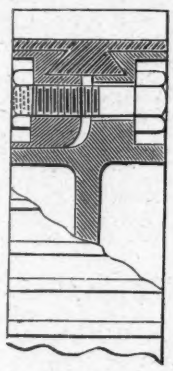


Fig. 2.—Compound Gear Wheel.

it is keyed, while the rim is formed in two halves, case-hardened, and held in position by a dovetail formed on the underside, the two halves being secured firmly by a large steel washer which is bolted to the body of the wheel as shown in the sketch.

It is said that any distortion of the rim by case-hardening will be pulled to shape by the dove-tailing, and the makers claim for the wheel that—

1. The teeth wear longer than the ordinary non-hardened steel.
2. The rims can be changed more quickly than the complete wheel of the usual pattern.
3. Replacements of the rim only will be cheaper than corresponding renewals of a split gear.

The sketch shows no provision of split pins or extra locking devices such as experience has proved to be necessary on gear wheel bolts, but that is a correction easily made, and it will be interesting to hear in 12 months' time the result of the first lengthy trials.

Electric Shot-firing Apparatus.

One of the many functions which can be efficiently fulfilled by no other agent but the electric current is that of exploding blasting charges from a distance, and the apparatus for generating the current for this purpose has been developed to a high degree of excellence. The Sterling Telephone and Electric Co., Ltd., of 200, Upper Thames Street, E.C., whose signalling apparatus has made their name familiar in the mining world, have now organised and placed on the market a complete range of shot-firing apparatus of the latest types, which will be made entirely at their works in this country, and we illustrate herewith a few of the machines. These include both magneto and self-exciting dynamos, capable of firing from 2 to 80 shots in series simultaneously. Low-tension fuses are generally used, and consequently the generators are mostly of the low-tension type, but magnetos wound for firing high-tension fuses are also made.

As a powerful effect is required for a moment only, all these machines are operated by hand, with a key, either by a single effort of the wrist or with the aid of a strong spring, which is wound up with the key and released by a catch. The internal construction is shown in some of the accompanying figures; fig. 3 shows a low-tension series-wound dynamo to fire three shots in series; fig. 5 is a more powerful machine, firing 25 shots in series, and weighing 8¾ lb. The firing contact is usually made automatically when the hand has made a half-turn and the speed of the armature is at its maximum. Fig. 4 shows the external appearance of the machine (fig. 3) in a metal case; oaken cases are also used. Some of the machines can easily be carried in the pocket—for instance, that shown in fig. 4 measures less than 4 in. square × 2¼ in. thick and weighs 3 lb. In a recent pamphlet, free on application, the company not only gives particulars of these machines and other mining accessories, but also includes an excellent little treatise on the whole subject of electric shot-firing, with illustrations showing clearly the method of operating the machines.

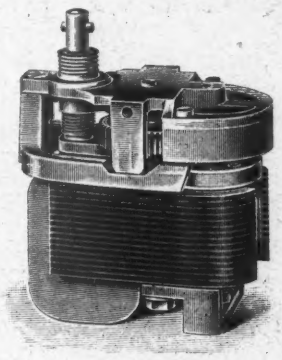


Fig. 3.

Fig. 4.

Sterling Electric Blasting Machine, Type B D.

The "Hot Point" Electrical Flat-iron.

A series of "hot point" irons have been developed in the workshops of Messrs. Eastman & Son, dyers and cleaners, of Acton Vale, W, who have been large users of such apparatus since 1902, and have therefore had excellent opportunities of judging, from the user's point of view, just what is required in this connection.

The irons are made in the following sizes:—3 lb. (200 watts) and 4 lb. (275 watts), for domestic use; 5 lb. (300 watts) and 6 lb. (360 watts), for laundry work; 8 lb. (440 watts), for dyers and cleaners; and 12 lb. (500 watts), for tailors, &c. Each iron is provided with 2 yards of flexible cord. The pressure—anything up to 250 volts, A.C. or D.C.—is stamped on the irons, which in the heaviest sizes can be supplied plated.

The heating elements in these irons, one of which we have examined, are placed in narrow vertical slots running from point to base, and consist of suitable coils wound on strips of insulating material and efficiently insulated. The arrangement is claimed to dissipate nearly the whole of the heat on to the face of the iron and equally to the point—an advantage which is obvious; the heating elements also are easily renewable, and the design simple and cheap to produce. The irons have been developed as a result of two years' experiment in daily work by Messrs. Eastman's engineer, Mr. Alan Warne, and are obtainable from Eastman and Warne, Acton Vale, W.

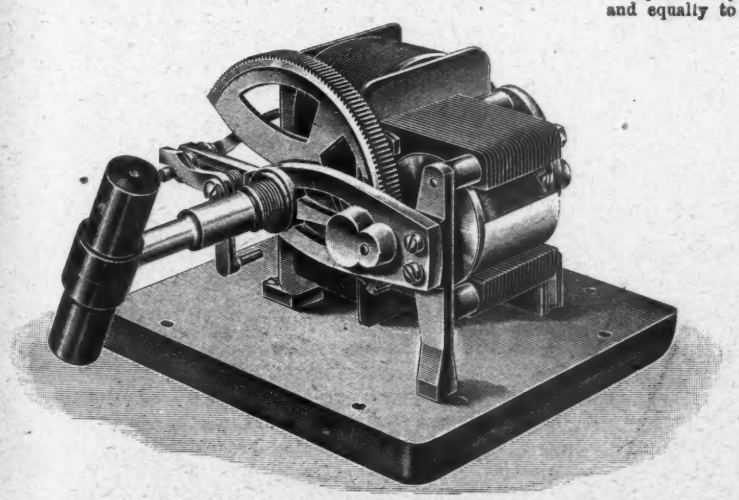


Fig. 5.—Sterling Exploder, Type D.

Fig. 6.—Type D in Metal Case.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

CONGO FREE STATE.—The following goods pay a duty of 3 per cent. *ad valorem*: Steam engines, mechanical apparatus used in industry, locomotives, wagons and materials for railways in operation.

The following goods are admitted free of duty: Locomotives, railway wagons and materials during the period employed in the construction of the lines and until they are opened for traffic, scientific instruments.

Other electrical and similar goods pay a duty of 10 per cent. *ad valorem*.

The value of imported goods for purposes of calculation of duty is the value at the place of origin or manufacture of the goods, increased by the charges for freight, insurance and commission, incurred on the goods up to the time of their arrival at the port of importation. This value does not include that of the packages, but should the authorities consider that the packages can be used for purposes other than that of transportation of the goods, the declaration of their value may be insisted on in view of levying duty thereon.

The import declaration must indicate the country of origin of the goods, the name, nationality and port of departure of the vessel carrying the goods, the name of the captain or master, the number, kind, marks and numbers of the imported packages, the kind of goods contained in such packages, the value of the goods, the locality or factory to which they are destined and any other details necessary.

COREA.—The following duties are payable:—

Cement, Portland or other	7½ %	ad val.
Chemicals of all kinds	7½ %	„
Glassware of all kinds	10 %	„
India-rubber, manufactured or not	10 %	„
Lamps of all kinds	7½ %	„
Metals of all kinds in pig, block, ingot, slab, bar, rod, plate, sheet, hoop, strip, band and flat, T and angle iron, old and scrap iron	5 %	„
Metals of all kinds in pipe and tube, corrugated or galvanised, wire, steel, tin plates, quick-silver, nickel, platina, German silver, yellow metal, tutenag or white copper, unrefined gold and silver	7½ %	„
Metal manufactures of all kinds, such as nails, screws, tools, machinery, railway plant and hardware	7½ %	„
Porcelain, common qualities...	7½ %	„
„ superior qualities...	10 %	„
Resin	7½ %	„
Scientific instruments, as physical, mathematical, meteorological and surgical, and their appliances	free	
All unenumerated goods, raw or unmanufactured...	5 %	ad val.
„ „ partly manufactured ...	7½ %	„
„ „ completely manufactured	10 %	„

In the case of imported goods the *ad valorem* duties of the tariff will be calculated on the actual cost of the goods at the place of production or fabrication, with the addition of freight insurance, &c. Duties may be paid in Mexican dollars or Japanese silver yen.

NEW PATENTS APPLIED FOR, 1909.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool and Bradford, to whom all inquiries should be addressed.

9,805. "Electric automatic equilibrium restorer for imparting stability to, or improving the stability of, aeroplanes, balloons and other machines for aerial navigation." J. Galea. April 26th. (Complete.)

9,807. "Improvement in expansion plugs for electrical switchboard bus-bars." T. H. Lurring, T. W. Dychek and J. Moran. April 26th.

9,808. "Improvements in long-pull electromagnetic apparatus." F. J. Jervis Smith. April 26th.

9,810. "Improvements in swinging joints of electric light and similar tubular fittings." Veritys, Ltd., and D. E. Rogers. April 26th.

9,812. "Improvements in incandescent electric lampholders and shade carriers." W. R. Mackay. April 26th. (Complete.)

9,829. "Improvement in or applicable to electric controller contact fingers." F. Jackson and W. L. Hurst. April 26th.

9,831. "Electric automatic circuit breaker." W. Ainsley, J. Johnson, T. G. Parkes and W. Porritt. April 26th.

9,951. "Improvements in and relating to electric reflector lights." C. C. Regnart. April 27th.

9,971. "Improvements in conduit junction boxes and conduit inspection fittings." W. Schmahl. April 27th.

9,972. "Mechanical electrical figure or apparatus for performances in theatres and other places of amusement." O. Sidmann. April 27th.

9,980. "Improvements in or relating to electric traction on the induction system." D. Suchostawer. April 27th.

9,987. "Lightning arrester for overhead lines." G. Krause. (Date applied for under Sec. 91 of the Act, July 20th, 1908, being date of application in Germany.) April 27th. (Complete.)

9,999. "Improvements relating to sheet-metal telephone cases." C. E. Bilton. April 27th. (Complete.)

10,003. "Arrangement of connections for electric tension measurement apparatus of dynamometric construction." T. Horn. (Date applied for under Sec. 91 of the Act, April 27th, 1908, being date of application in Germany.) April 27th. (Complete.)

10,025. "Improvements in trolley heads or collectors for electric tramcars and the like." S. H. Campbell. April 28th.

10,052. "Improved means for joining the ends of submarine or other telegraphs and like cables." J. F. Dyson. April 28th.

10,067. "Improvements in or relating to arrangements for the cooling of commutators of dynamo-electric machines." Siemens Bros. Dynamo Works, Ltd., and F. F. O'Hagan. (Siemens Schuckertwerke G.m.b.H., Germany.) April 28th. (Complete.)

10,076. "Improvements in variable speed gear mechanism applicable to all kinds of machines, electric and other motors, automobiles or the like." J. G. Stirk. April 28th.

10,099. "Improvements in magneto-electric machines." F. R. Simms and Simms Manufacturing Co., Ltd. April 28th.

10,121. "Improvements in and relating to electrical registering devices of scores or numbers won on or by any ball playing game such as bagatelle or the like." F. J. Thomas. April 29th.

10,175. "Improvements in or relating to a cooling device for electrical sliding contacts." B. von Ugrimoff. April 29th. (Complete.)

10,198. "Automatic electric generating systems." M. A. Newsteiter. April 29th. (Complete.)

10,203. "Improvements relating to service registers in telephone installations." Siemens Bros. & Co., Ltd. (Siemens & Halske Akt.-Ges., Germany.) April 29th. (Complete.)

10,223. "Improved method of motor propulsion of automatic telegraph and like mechanisms by means of a variable speed motor controlled by a friction and fan governor, also automatic starting and stopping of polarised receiving motor-driven apparatus." P. Mulligan. April 30th.

10,225. "Improvements in electric current generators and electric motors." J. MacDonald. April 30th.

10,255. "Improvements in telephonic part-line systems." M. S. Conner. April 30th.

10,283. "Improvements in lifting magnets." A. C. Eastwood. April 30th. (Complete.)

10,312. "Improvements in electric safety lamps." G. O. Wolters. (Date applied for under Sec. 91 of the Act, May 2nd, 1908, being date of application in Germany.) April 30th. (Complete.).

10,348. "Improvements in conduit fittings for electrical and other purposes, and in the manufacture of same." A. Brampton and F. Osborn. (Application for Patent of Addition to No. 8,601/1909.) May 1st.

10,396. "Improvements in and relating to supports for incandescent electric lamp filaments." British Thomson-Houston Co., Ltd. (General Electric Co., United States.) May 1st.

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool and Bradford price, post free, 9d. (in stamps)

1908.

Apparatus for Controlling Electric Motors. J. H. Hindle. 177. January 3rd.

Controllers for Electric Motors. Crompton & Co. and C. Crompton. 4,799. March 3rd.

System of Electric Wiring. W. Fennell and W. P. Perry. 6,972. March 30th.

Process of and Means for Depositing Metals upon Metallic Surfaces. A. Rosenberg. 7,227. April 1st.

Watertight Holders for Incandescent Electric Lamps. E. G. Byng and C. E. Gunner. 7,593. April 6th.

Alternating-Current Electric Motors of the Compensated Repulsion Type. Ateliers Thomson-Houston. (Anciens Etablissements Postel-Vinay.) 7,621. April 6th. (Date applied for under International Convention, April 6th, 1907.)

Electric Meters for Limiting the Amount of Electrical Energy which may Pass through a Circuit to a Predetermined Quantity. W. Fennell and W. P. Perry. 7,646. April 7th.

Electric Reciprocating Tools. A. F. Carver. 7,800. April 8th.

Electric Meter Systems. Nalder Bros. & Thompson, Ltd., H. W. Handcock and A. H. Dykes. 7,886. April 9th.

Electric Braking. P. S. Turner. 7,911. April 9th.

Dynamo-Electric Machines. British Thomson-Houston Co. (General Electric Co., United States.) 7,943. April 9th.

Production of High Frequency Electrical Oscillations. O. Scheller. 8,277. April 14th. (Date applied for under International Convention, August 13th, 1907.)

Choking Coils for Use with Arc Lamps. L. O. Langworthy. 8,298. April 14th.

Reinforced Concrete Pole or Mast for Supporting Electric Conductors or for other Purposes. H. W. Oberlies. 8,528. April 16th.

Commutating Dynamo-Electric Machines. V. A. Fynn. 9,033. April 25th.

Trolley Head for Electric Tramcars. J. O. Millard. 9,360, April 30th.

Electric Furnaces. C. E. Knowles. 13,502. June 25th.

Electric Railways on the Conduit System. A. H. Angle. 14,328. July 6th.

Control of Induction Motors. Rhodes Motors, Ltd., and C. H. Fielden. 14,518. July 8th. (Application for Patent of Addition to No. 18,956/07.)

Signal Systems for Railways and the Like. British Thomson-Houston Co. (General Electric Co., United States.) 14,868. July 13th.

Current Collectors or Contact Arms for Electric Traction. Railless Electric Traction Co. (M. Schiemann.) 15,753. July 24th.

Control of Electric Motors. J. G. V. Lang. 20,969. October 5th.

Electricity Meters. H. Aron. 21,576. October 12th.

Means for Operating Electric Railway Track Points and Switches. P. M. Justice. (American Automatic Switch Co.) 27,906. December 22nd.

1909.

Electrode for Searchlights. Firm of Gebr. Siemens & Co. 1,316. January 19th. (Date applied for under International Convention, April 9th, 1908.) (Application for Patent of Addition to No. 13,071 of 1907.)

Magneto Ignition Apparatus for Multi-Cylinder Internal-Combustion Engines. W. P. Thompson. (Mea Fabrik Magnet Elektrischer Apparate Ges.) 3,199. February 9th.

Device for Lubricating the Interrupter Cams of Magneto Ignition Apparatus. Firm of R. Bosch. 3,759. February 15th. (Date applied for under International Convention, October 31st, 1908.)

Single-Phase Alternating-Current Electric Commutator Motors. Maschinenfabrik Oerlikon. 4,662. February 25th. (Date applied for under International Convention, February 26th, 1908.)